New Light on Old Glass: Recent Research on Byzantine Mosaics and Glass

Edited by Chris Entwistle and Liz James

The British Museum

In memoriam
Daniel Thomas Howells (1984–2011)

Publishers
The British Museum
Great Russell Street
London WC1B 3DG

Editor
Sarah Faulks

Distributors
The British Museum Press
38 Russell Square
London WC1B 3QQ

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Recent Research on Byzantine Mosaics and Glass
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ISBN 978 086159 179 4
ISSN 1747 3640

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Front cover: The Lycurgus cup in transmitted light,
4th century. British Museum, London (PE 1958,1202.1)

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Preface

The papers in this volume come from a conference held at the British Museum between 27 and 29 May 2010. This conference was the culmination of a three year Leverhulme Trust funded International Network, *The Composition of Byzantine Glass Mosaic Tesserae*, and the papers published here, both from core members of the Network and some of the other scholars who have been associated with it, gather together many areas of our discussions and debates. The conference also included a number of more general papers on the subject of Late Antique, Byzantine and Islamic glass which were presented under the auspices of the British Museum Byzantine Seminar which shared the programme with the International Network.

The Network brought together chemists, glass scientists, archaeologists, art historians and conservators working in glass and mosaic studies across Europe and the United States to pool information about Byzantine glass mosaics and to reappraise mosaics and mosaic making in this interdisciplinary context. The Network has created an online glossary of technical terms and several online databases recording sites of mosaics and texts about mosaics. The project website is available at: http://www.sussex.ac.uk/byzantine/research/mosaictesserae and the glossary and databases at www.sussex.ac.uk/byzantine/research/mosaictesserae/publications.

Liz James is very grateful to the Leverhulme Trust for their support and would like to take the opportunity to thank the core Network Team of Chris Entwistle, Cesare Fiori, Ian Freestone, Julian Henderson, Marie-Dominique Nenna, Mariangela Vandini, Maria Vassilaki and Marco Verità for all their enthusiasm, hard work, support and encouragement throughout the period of the Network. Thanks are also due to Bente Bjørnholt, the Network Facilitator, for her assistance with translation and without whom many events, including this conference, would not have happened, and to Michelle O'Malley and Amelia Wakeford for all their assistance. Liz James would also like to thank those many scholars who joined the series of Network events in Italy, Greece and the UK, and at this conference, and whose many contributions helped make the Network a success.

Chris Entwistle would like to thank Liz James and everyone mentioned above, and both editors would like to thank Sarah Faulks, Series Editor of the British Museum Research Publications, for all her work on the volume.

This volume is dedicated to the memory of Dan Howells. Dan successfully completed an outstanding PhD with us about the British Museum's collection of gold glass. He was involved with the Network and had helped in the running of the conference. His sudden, untimely death was a shock to all who knew him.

Chris Entwistle and Liz James

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Chapter 1
Glass Mosaic Tesserae from the 5th to 6th Century Baptistery of San Giovanni alle Fonti, Milan, Italy
Analytical Investigations

Elisabetta Neri, Marco Verità and Alberto Conventi[1]

Introduction

During the period in which Milan was the capital city of the western Roman Empire (AD 286–402), many new buildings were erected as a result of imperial patronage. These buildings followed contemporary aesthetic criteria, not only architecturally but through interior decoration as well.[2] This new style of decoration can also be found in a number of Milan's Early Christian buildings, such as the mausoleum and the basilica of San Lorenzo.[3] Within this historical-archaeological framework, which is still unclear because of the poor preservation state of the buildings, it is likely that mosaics played a significant role. This raises a number of questions. Which artisans made the wall inlays where glass pastes and marble coexisted? Were glass tesserae produced locally or were they imported? Were they newly made or reused?

Previous hypotheses have argued for the presence of a workshop in Milan that produced coloured glass for tesserae made in the 4th to 12th century. Though not an unreasonable proposition, this hypothesis still lacks sound evidence from an archaeological point of view and an accurate definition of historical and stylistic contexts. As a result, differing conclusions have been formulated as to the origins and dating of the workshops and their products.[4]

In the course of the present investigation, the materials uncovered in the collapsed layers of the Baptistery of San Giovanni alle Fonti in Milan have been examined. X-ray microanalysis and scanning electron microscopy have been used to identify the nature of the glass, colourants, pigments and opacifiers of coloured and gold leaf tesserae, and to point out similarities with and differences to contemporary tesserae recovered from other sites.

Samples

A recent archaeological investigation has demonstrated that the baptistery of the Milanese episcopal building complex was built in the second half of the 4th century and sponsored by Bishop Ambrose. Parts that had been destroyed were later rebuilt by Bishop Laurence between the late 5th and early 6th centuries.[5] It is most likely that the mosaics date to this later period, and Magnus Felix Ennodius mentions these wall decorations in his celebration of Bishop Laurence's involvement in the rebuilding of the baptistery. In 1355, a systematic dismantling of the mosaics was ordered.[6]

The majority of the materials of the mosaic decoration were found in the demolition layers of the building during excavations carried out by Bignami towards the end of the 19th century and Mirabella Roberti in the 1960s. Their finds include 271 pieces of mosaic fragments and loose tesserae, which was slightly less than 1% of the supposed original mosaic surface.[8] Some fragments are actually conserved in the baptistery's 'antiquarium'.

According to the colour percentages of the excavated tesserae, the mosaic must have had a gold ground, while green-blue tesserae were most prominent in the decoration. Up to five or six colours were used, each one in a variety of hues, sometimes both translucent and opaque. Several slab edge pieces have been found of both coloured and gold leaf tesserae (the latter amount to approximately 20% of the preserved tesserae). This allows the suggestion that the glass

cakes were cut *in situ*, though it cannot be conclusively excluded that these were reused materials.

Because of the severe deterioration of most of the tesserae, which were completely covered with yellowish and white weathered glass, a soft abrasion treatment and observation under the optical microscope was necessary in order to identify their real aspect and chromatic hue. As far as possible, all the colours were sampled for all different hues, including both opaque and translucent types, as well as the different kinds of gold leaf tesserae.

The analyzed tesserae comprised: four opaque blue tesserae (F5, BL.op1,2,3), two translucent ones with many bubbles (BL.b1,b2) and a transparent one (A1); three opaque yellow tesserae (F1, F2 and B4) and two translucent yellow ones crossed by micro-fractures (Gi1a, Gi1b); five green-yellow tesserae with yellow pigments, two opaque (E1, Ve.Gi1) and three semi-opaque (F3, F4 and Ve1a) ones; one light green tessera with white particles (A2), a set of five tesserae of an unusual anise green colour (from Ve1 to Ve5; with increasing colour intensity) and one emerald green tessera (Ve6); two red tesserae (C2 and D1), one red-brown (Br1), and two orange tesserae with dark veins (F6, Ar.d); and, finally, two tesserae of a particular purple-brown colour (Vi.b weathered, Vi.c well preserved); one black tessera (Ne1) and an opaque white one (Bi1) (see **Table 1**).

With regard to the gold leaf tesserae, these were classified into two groups according to the aspect of the transparent glass: yellow-green hues in the first group (analyzed: B1c, B2s, B3c, C1s, D2s, E2s, Au.as; the final s or c indicate respectively the glass of the support or of the cartellina) and well decolourized glass in the second group (sample Au1s). In many cases the cartellina was absent or completely weathered. Small fragments of the gold leaf were sampled and set on a suitable sample holder to determine their composition.

Analytical techniques

Glass fragments requiring analysis were dry cut from the tesserae and embedded in cross-section in acrylic resin in a teflon mould. The discs containing up to six fragments were ground and polished with diamond pastes down to a 3μm grain size.[9]

The polished sections were observed by optical microscopy in reflected light (Leika MZ12) and by scanning electron microscopy (Philips XL 30) in backscattered mode, where the grey levels indicated areas with different chemical compositions. Semi-quantitative identification of the opacifiers and pigments was performed by energy dispersive X-ray microanalysis (EDAX). The quantitative X-ray microanalysis was undertaken using a Cameca SX-50.[10] Various reference glasses of certified composition were employed to improve the accuracy of the analyses. The EPMA setting used in this work allows most of the oxides to be analyzed in concentrations as low as 0.02–0.05%. Before SEM and X-ray analysis, the surface of the samples was carbon coated.

Results

The quantitative chemical compositions of the tesserae are reported in **Table 1**. Average values are reported for the coloured tesserae, which also include the glassy phase and opacifying or colouring particles. Hereafter, the base glass composition (composition of the transparent glass to which colourants and opacifiers were added) is discussed separately from colourants, pigments and opacifiers.

Base glass

The composition of the base glass was calculated by subtracting from the composition of the 'coloured glass' the content of colourants, decolourants and opacifiers and then normalising to 100 wt%. The differences in the content of some oxides in the base glass allow a few compositional groups to be established.

The composition of most of the tesserae is in agreement with the dominant glass type from the Roman period until the 8th to 9th century and is composed mainly of sodium, calcium and silicon oxides (soda-lime-silica glass), with potassium and magnesium oxides each below about 1.5% and phosphorous below 0.2%. Natron, a sodium carbonate mineral associated with lower amounts of chlorides and sulphates from Egypt,[11] was the flux used to produce this glass. It was mixed and fused together with a silica-lime sand in which quartz and calcium carbonate were present in suitable ratios to make glass. According to Pliny (*Nat. Hist.* XXXVI. 192),[12] this type of sand was quarried in a few sites such as the mouth of the River Belus (presently Na'aman, between Haifa and Acre in northern Israel) and the River Volturno (north of Naples, Italy). Archaeological evidence and analytical investigation suggest that in this period the practice of making glass was carried out in a limited number of places located near the sources of these raw materials in tank furnaces where several tons of glass could be melted. Once the glass had melted, the furnace was left to cool and then demolished. Large blocks of transparent glass, slightly coloured in natural hues ranging from green, yellow to light blue, were then broken up into chunks of raw glass that were traded throughout the Mediterranean and Europe and distributed to workshops where they were remelted and made into artefacts.[13] In the case of mosaic tesserae, once the raw glass had been remelted, it was coloured, opacified and then shaped into cakes from which the tesserae were subsequently cut. However, no secondary centres for the production of glass cakes for mosaic tesserae have been identified up to now.

Analyses of the gold leaf tesserae from Milan reveal that the yellow green glass was obtained by using sand with high amounts of iron (high titanium and alumina concentrations are also present) and only partially decolourizing the glass with manganese. In contrast, the perfectly colourless glass of sample Au.1s was obtained from purer sand (the iron content is about 50% less than that of the yellow green gold tesserae), and antimony was used together with manganese for the decolouration. In both types of tesserae the metal leaf is less than half a micrometre thick and is of pure gold (Au 100%). The composition of the cartellina (a thin layer of blown glass 0.5 to 0.7mm in thickness covering the metal leaf thickness) is practically the same as that of the support glass. The optical quality, however, is different, for the cartellina glass is homogeneous, while the support glass is heterogeneous and contains many bubbles.

The orange tesserae and two of the red tesserae (C2 and D1, not the Br1) are made with a soda-lime-silica glass

Table 1 Quantitative chemical composition in wt% of the oxides of the analyzed tesserae (OP = opaque; TR = transparent; transl = semi-opaque)

			SiO_2	Al_2O_3	Na_2O	K_2O	CaO	MgO	SO_3	P_2O_5	Cl	TiO_2	Fe_2O_3	MnO	Sb_2O_3	CuO	PbO	SnO_2	CoO	As_2O_3	ZnO
F5	blue	OP	68.0	2.60	15.0	0.45	7.70	0.70	0.25	0.13	0.65	0.07	0.90	0.85	1.50	0.10	1.00		0.05	0.08	
Bl.op1	blue	OP	66.7	2.40	14.5	0.60	7.90	0.53	0.33	0.15	0.60	0.08	0.70	0.95	3.00	0.15	1.30		0.06		
Bl.op2	blue	OP	65.8	2.40	15.5	0.63	7.50	0.45	0.32	0.16	0.60	0.05	0.75	0.90	3.50	0.12	1.15		0.05		
Bl.op3	blue	OP	66.6	2.18	14.2	0.50	6.90	0.51	0.40	0.17	0.55	0.05	1.45	0.95	3.70	0.34	1.15		0.25	0.05	
Bl.b1	blue	transl	67.6	2.40	17.5	0.52	6.65	0.85	0.26	0.07	0.85	0.18	1.10	0.85	0.70	0.15	0.18		0.05	0.08	
Bl.b2	blue	transl	67.0	2.50	17.0	0.63	6.90	0.90	0.13	0.07	0.78	0.20	1.45	1.40	0.25	0.20	0.37	0.08	0.06	0.07	
A1	blue	TR	66.8	1.88	20.7	0.30	5.70	0.80	0.25	0.02	1.40	0.07	1.40	0.08		0.18	0.40		0.04		
F1	yellow	transl	64.2	2.40	20.0	0.43	5.50	0.78	0.33	0.05	0.95	0.26	1.20	0.50		0.50	2.50	0.30		0.10	
F2	yellow	transl	64.7	2.30	20.3	0.35	5.40	0.73	0.36	0.05	0.95	0.24	1.15	0.45		0.50	2.00	0.45		0.10	
B4	yellow	transl	64.4	2.25	20.0	0.50	5.60	0.80	0.43	0.06	1.20	0.23	1.20	0.45		0.40	2.20	0.30			
Gi1-a	yellow	OP	63.4	1.50	16.8	0.31	5.05	0.38	0.18	0.03	0.80	0.05	0.35	0.03			9.30	1.70		0.09	
Gi1-b	yellow	OP	67.0	1.70	17.3	0.33	5.40	0.45	0.18	0.03	0.90	0.10	0.35				5.70	0.50		0.10	
E1	green-yellow	OP	62.3	2.27	18.2	0.48	5.90	1.05	0.25	0.07	1.00	0.21	1.10	1.10	0.25	0.45	4.70	0.65			
Ve.Gi1	green-yellow	OP	62.4	2.60	18.8	0.36	6.30	1.25	0.27	0.07	0.65	0.55	1.75	1.95			2.80	0.15		0.04	
F3	green-yellow	transl	65.0	2.20	19.0	0.48	6.70	0.80	0.20	0.10	1.00	0.13	0.90	0.30		1.10	1.80	0.20		0.10	
F4	green-yellow	transl	64.5	2.30	19.2	0.53	6.70	0.85	0.24	0.08	0.90	0.13	0.80	0.40		1.10	1.90	0.25		0.12	
VE.1a	green-yellow	transl	62.5	2.15	20.0	0.25	6.60	1.15	0.22	0.05	1.00	0.13	1.30	0.10		2.10	1.00	1.00		0.08	0.40
A2	light green	transl	65.6	2.30	19.6	0.56	6.25	0.92	0.28	0.08	1.05	0.14	0.85	0.88	0.55	0.70	0.13	0.05			
Ve1	anise green	OP	64.0	2.40	18.0	0.52	7.00	1.00	0.27	0.06	0.75	0.28	1.10	1.55		0.05	1.05	2.00		0.04	
Ve2	anise green	OP	66.5	2.35	18.0	0.52	6.20	0.88	0.30	0.09	0.80	0.16	0.80	0.90	1.15	0.38	0.40	0.40		0.03	
Ve3	anise green	OP	66.5	2.35	18.2	0.52	6.30	0.87	0.28	0.08	0.78	0.15	0.82	0.90	1.10	0.35	0.40	0.40		0.04	
Ve4	anise green	OP	66.0	2.40	18.2	0.60	7.00	0.90	0.25	0.08	0.85	0.15	0.90	0.85	0.45	0.67	0.55	0.10		0.05	
Ve5	anise green	OP	65.5	2.25	18.3	0.45	6.00	0.90	0.25	0.05	0.90	0.22	0.85	1.00	0.43	0.70	0.57	1.50		0.04	
Ve6	emerald green	OP	60.4	2.50	15.5	0.69	6.80	0.80	0.23	0.15	0.75	0.09	0.94	0.53	0.55	2.00	7.00	1.00		0.03	

Table 1 (continued) Quantitative chemical composition in wt% of the oxides of the analyzed tesserae

			SiO_2	Al_2O_3	Na_2O	K_2O	CaO	MgO	SO_3	P_2O_5	Cl	TiO_2	Fe_2O_3	MnO	Sb_2O_3	CuO	PbO	SnO_2	CoO	As_2O_3	ZnO
C2	red	OP	55.8	3.40	13.3	1.21	6.45	1.80	0.20	0.50	0.70	0.54	3.40	0.38		1.60	8.00	1.10			1.60
D1	red	OP	50.5	2.90	11.5	1.11	5.70	1.30	0.15	0.40	0.70	0.34	3.00	0.15		1.90	18.0	1.50			0.80
Br1	red brown	OP	61.5	2.13	16.8	0.66	5.90	0.76	0.17	0.12	0.88	0.12	5.00	1.05		0.50	3.30	0.55		0.10	0.35
F6	orange	OP	41.5	3.00	8.2	1.30	5.20	1.20	0.17	0.47	0.47	0.30	3.00	0.55	0.07	5.00	27.0	1.50		0.25	0.40
Ar.d	orange	OP	41.2	2.70	10.8	1.35	4.95	1.25	0.25	0.45	0.55	0.35	2.20	0.65	0.09	4.40	27.0	1.15		0.20	0.45
Vi.b	purple-brown	transl	66.3	2.25	19.8	0.46	6.40	0.93	0.28	0.06	0.83	0.20	0.75	1.60						0.05	
Vi.c	purple-brown	transl	66.7	2.30	19.5	0.40	6.40	0.90	0.30	0.07	0.81	0.13	0.78	1.55						0.07	
Ne1	black	TR	63.8	2.05	19.5	0.33	5.75	0.74	0.21	0.05	1.15	0.13	6.00	0.05		0.05				0.11	
Bi1	white	OP	65.3	2.30	16.9	0.45	6.40	0.90	0.24	0.08	0.70	0.30	1.15	1.70			1.10	2.50			
B1c	gold yellow-gr.	TR	64.0	2.55	20.4	0.39	6.00	1.47	0.25	0.05	1.25	0.30	1.60	1.70							
B2s	gold yellow-gr.	TR	64.3	2.50	20.0	0.42	6.25	1.40	0.32	0.06	1.10	0.26	1.50	1.85							
B3c	gold yellow-gr.	TR	63.7	2.53	21.0	0.41	6.40	1.20	0.35	0.06	1.15	0.25	1.40	1.50							
C1s	gold yellow-gr.	TR	62.8	2.60	21.5	0.40	5.60	1.40	0.32	0.08	1.15	0.40	1.75	2.00							
D2s	gold yellow-gr.	TR	61.7	2.60	21.8	0.38	5.10	1.35	0.30	0.06	1.15	0.40	3.15	2.00							
E2s	gold yellow-gr.	TR	62.3	2.75	21.5	0.37	5.10	1.40	0.38	0.05	1.20	0.41	1.50	3.00							
Au.as	gold yellow-gr.	TR	65.8	2.55	19.3	0.38	5.90	1.15	0.25	0.08	0.80	0.50	1.25	1.90							
Au.1s	gold colourless	TR	69.0	2.15	19.0	0.64	4.90	0.60	0.30	0.12	0.70	0.10	0.60	0.42	1.20		0.20				

Plate 1 Polished section of fragments of the anise green tesserae (from left to right: Ve3, Ve4 and Ve5). Long side of the optical micrograph: 18mm

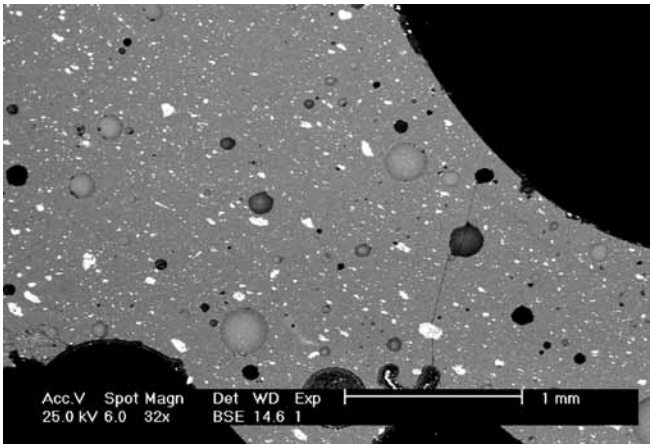


Plate 2 SEM micrograph of the polished section of a fragment of the green tessera Ve1. Bubbles and aggregates of tin oxide crystals (white areas) are randomly dispersed in the glassy phase

different from the natron type. In these samples the higher Mg, K and P contents indicate the use of a soda plant ash glass. The use of a different base glass melted from a batch of soda ash and silica sand is commonly found for orange and red Roman glass.[14]

Colourants and opacifiers

The colourant of the blue tesserae is cobalt. In these tesserae, traces of copper (its concentration is too low to modify the intense colour given by cobalt), lead and iron (in higher concentrations as compared with other glasses) were detected. These elements were introduced unintentionally with the cobalt ore which was added to a glass previously decolourized with manganese (except for sample A1). A number of these tesserae are translucent owing to the presence of bubbles and rare aggregates of white crystals (Bl.b01 and Bl.b02). Unexpectedly, in sample Bl.b01 these aggregates consist of calcium antimonate, while in sample Bl.b02 they are of tin oxide. Even more surprising is the presence of antimony in the glass of this last sample (Sb_2O_3 0.25%), while tin was found only in sample Bl.b02. To intensely opacify the blue tesserae, calcium antimonate crystals were used.

The 'black' colour of sample Ne1 is due to the intense green-yellow colour of the transparent glass obtained by adding iron and keeping the melt in reduced conditions (with low oxygen) so as to favour the formation of the iron-sulphur amber chromophore.

The five anise green tesserae show increasingly darker hues from sample Ve1 (lightest colour) to Ve5 (darkest colour); this colour is peculiar and infrequent in mosaic tesserae (**Pl. 1**). The transparent glass of these tesserae is coloured with copper and iron; the colour of the first three tesserae changes to a more marked light blue hue in samples Ve4 and Ve5. The compositions of the five tesserae are fairly similar. The observation of the polished sections under the electron scanning microscope reveals the presence of tin oxide (SnO_2, cassiterite) particles up to 150 micrometres in size, more abundant in tesserae Ve1 and Ve5, which were used to clarify the colour (**Pl. 2**). Unexpectedly, some isolated particles of calcium antimonate are also present in sample Ve2. In all these tesserae (except Ve1), a certain amount of antimony was also found dissolved in the glass, though no calcium antimonate crystals were identified. As

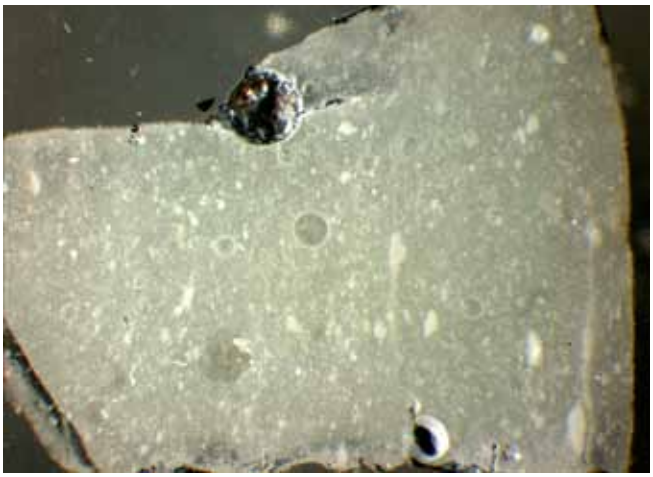
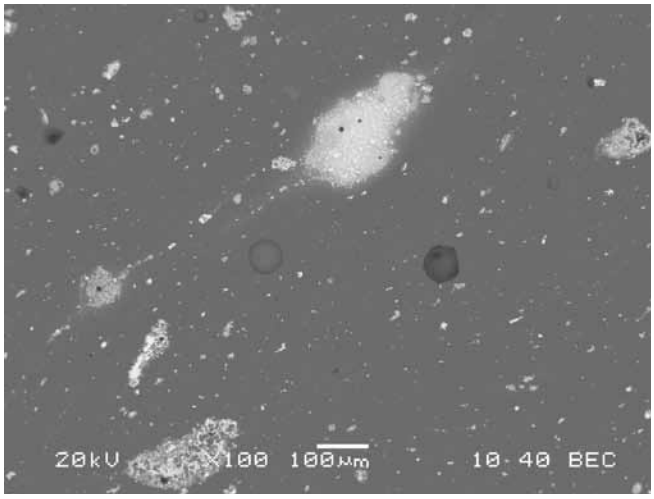


Plate 3 Polished section of a fragment of the white tessera Bi1 opacified with tin oxide. The optical micrograph (long side of the micrograph: 2.3mm) shows the heterogeneity of the tessera

previously illustrated, a similar result of glass containing antimony opacified with tin oxide was observed for some blue tesserae, whilst it was used in Islamic and Venetian red enamels on glass in the 13th century.[15]

Sample Ve6 exhibits a peculiar intense emerald green colour due to a high copper and lead concentration (the lead content is probably related to the use of a copper-lead metal slag as a colourant). In the section examined under the optical microscope, some isolated yellow particles were observed alongside numerous white particles. X-ray microanalysis revealed that the yellow particles were composed of lead and tin and the white particles were tin oxide. Antimony was also detected in this tessera, but no crystals containing this element were found. The dark green colour of the transparent glass of sample Ve.Gi.1 (coloured with iron and copper) was modified by adding lead stannate yellow particles. Rare tin oxide white particles were identified, maybe as a result of the decomposition of yellow pigment particles.

Sample Bi1 is an opaque ivory-white tessera with very interesting analytical features. When examined under the optical microscope it appears to be a rough, heterogeneous tessera with white particles (**Pl. 3**). When examined under the SEM the particles are distinguished in large geometric



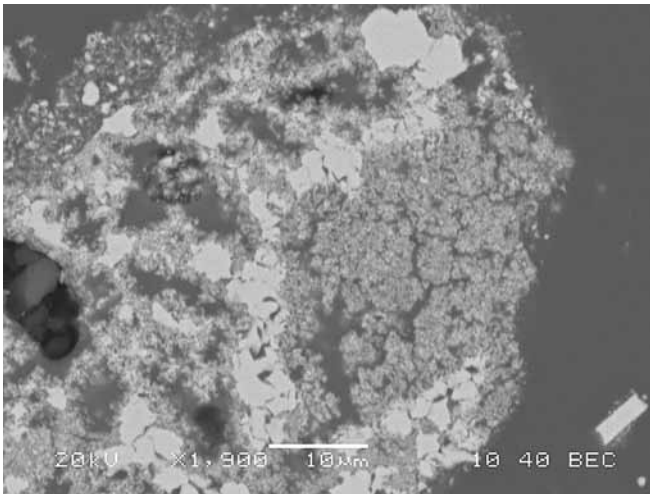


Plate 4–b SEM micrographs of the polished section of the white tessera Bi1. White areas correspond to tin oxide crystals and aggregates

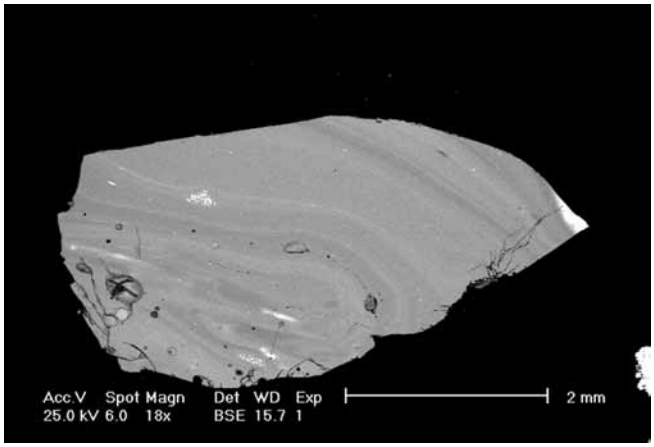
crystals and micro-crystals often grouped in clusters (**Pl. 4a**). Both geometric and micro-crystals are made of tin oxide. The clusters show an elongated form, which indicates a rapid stirring of the melt and pouring into slabs (**Pl. 4b**).

Pigments

Among the mosaic tesserae of the Baptistery of San Giovanni alle Fonti, yellow and green-yellow tesserae are most abundant. Minute yellow crystals (in the order of a micrometre in size) are dispersed in the colourless or green glass, individually or aggregated in particles a few tens of micrometres in size. The crystals and aggregates are arranged in layers, which indicates that they were added to the molten glass and roughly mixed. X-ray microanalysis revealed the fairly homogeneous composition of these pigments, which consist mainly of lead and tin (PbO 58–62%; SnO_2 28–32%), beside silica (SiO_2 around 5%) and iron (Fe_2O_3 1%). This composition corresponds to lead stannate yellow crystals.

The orange samples F6 and Ar.d were obtained from a transparent glass of the soda ash type to which considerable amounts of lead (PbO 27%) were added, together with copper, iron and lower amounts of tin and zinc. The colouring element is the copper, which forms very tiny cuprite crystals (Cu_2O), orange in colour. The dark layers correspond to transparent green zones free of pigments or to opaque red zones coloured by large dendritic crystals of cuprite. Lead, iron and zinc, which are commonly found in orange glass of the Roman period, are elements that favour the separation of the pigments from the melt during cooling (this phenomenon occurs only with suitable redox conditions). As for red glass (see below), it is probable that these elements were introduced through copper slag.[16]

Plate 5 SEM micrograph of the polished section of a fragment of the red-brown tessera Br1



In the red tesserae C2 and D1, the base glass is of the soda ash type, coloured by minute spheres of metallic copper and less abundant, but larger dendritic crystals of cuprite. The separation of the colouring compounds from the melt was favoured by the addition of iron, probably as ferrous oxide. This compound also modifies the colour, shifting it progressively to a red-brown hue. High concentrations of lead, tin and zinc were found, probably added as a metallic slag of copper. The red brown tessera (Br1: natron-type glass) shows opaque dark red streaks alternated with transparent green ones. The red colour is achieved by metallic copper particles; the concentrations of lead and tin are lower than those of the other red tesserae, but the iron content is higher. The chemical compositions of the red and transparent green streaks are similar. In the latter, the pigment has dissolved and the copper ion determines the dark green colour. The SEM analysis reveals a heterogeneous situation, showing the presence of tin oxide particles or aggregates and glassy streaks rich in lead (**Pl. 5**).

A group of tesserae with peculiar colours were obtained through specific techniques. In order to obtain the green-yellow colour of tessera (VE.1a), yellow (lead stannate), white (cassiterite), black (not identified) pigments and fragments of terracotta were added to a green bubble-rich transparent glass coloured with copper and iron (lead, tin and zinc are present also in this case) (**Pl. 6**). Another sophisticated technique was used to prepare the purple-brown tesserae (Vi.b e Vi.c), obtained from a transparent purple glass coloured with manganese, to which lamellar reddish iron particles (probably haematite, ferric oxide) were added. The lamellae are often aggregated in larger particles (**Pl. 7**); their irregular dispersion in the glass and the presence of bubbles suggest that this colourant was prepared separately, added to the molten glass, quickly

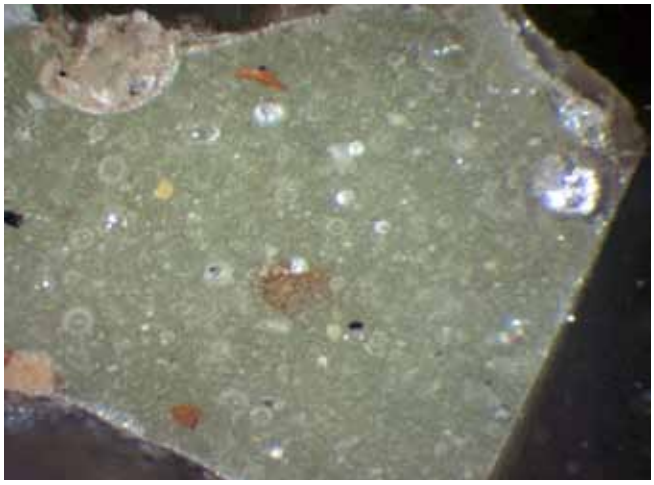


Plate 6 Optical micrograph of the polished section of a fragment of the green-yellow tessera VE.1a. Long side of the micrograph: 2.3mm

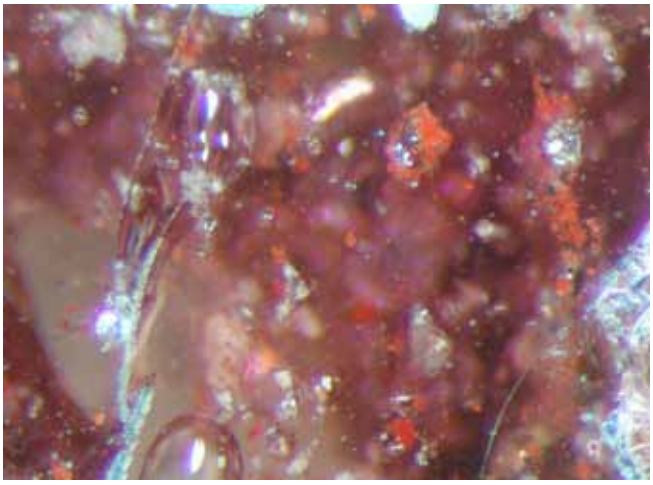


Plate 7 Optical micrograph of the polished section of a fragment of the purple-brown tessera Vi.b. Long side of the micrograph: 1.8mm

stirred and poured into slabs to avoid dissolution of the pigment. As far as the authors know, this colouring technique has never been found in mosaic tesserae.

Devitrification crystals

Needle-like or geometrically shaped, sometimes aggregated crystals are present in many tesserae in varying amounts, particularly in red, yellow and black tesserae. These crystals are made of calcium and silica, two of the major components of glass, and separate from the molten glass when it is kept at around 900°C (this is the temperature at which the molten glass was apparently kept before being poured into slabs). In some the 'devitrified crystals' reached a considerable size (for instance in the black tessera), thus increasing glass fragility and causing serious problems in cutting the tesserae.

Discussion

The picture resulting from the analyses is fairly complex. Some distinctive features emerged when the tesserae from the baptistery were compared with tesserae from the basilicas in Rome and Ravenna. Green and yellow tesserae were opacified with lead stannate particles and show a refined modification of the hue obtained by sometimes adding terracotta fragments and black pigments. The unusual anise green colour was obtained through the introduction of copper and iron, and lighter hues were achieved through increasing amounts of tin oxide crystals. These crystals were used to colour the white tessera. The purple-brown colour was achieved through a transparent purple glass coloured with manganese to which red flakes of iron oxide were added. In contrast, red and orange colours were made following the Roman tradition of glassmaking, with some idiosyncrasies that bring them more in line with practices in the Ravenna region.

The blue tesserae opacified with antimony (Bl.b01) may be reused ones following the Roman tradition or imported from other production sites (for example Rome). The lighter blue translucent tesserae, containing some antimony dissolved in the glass (indicative of the remelting of glass cullet), were clarified with tin oxide crystals. It is well known that in several periods the production of the blue colour was difficult not only for technological reasons but mainly as a result of the difficulties in acquiring the cobalt ore. This shortage was compensated for by remelting recycled blue glass.[17]

Base glass

The majority of the analyzed tesserae show a typical Roman glass composition. Some sub-groups can be distinguished, following a classification of the Roman glass.

A first sub-group includes the gold leaf tesserae characterized by a yellow-green hue, some yellow tesserae (F1, F2, B4) and the green-yellow tessera Ve.Gi1, all of which display high Na, Mg, Al, Fe and Ti contents with low Si and Ca contents. These compositional characteristics are compatible with a natron glass termed HIMT (high iron, manganese and titanium), which was widespread in Europe and the Mediterranean area between the 4th and 7th centuries.[18] The geographical source of this glass has not yet been identified although some authors suggest an Egyptian origin. However, the provenance of the raw glass is not significant enough to establish the production site of the mosaic tesserae. In the present case, it was remelted to obtain glass cakes in secondary sites, which were probably far from the primary glassmaking centres. Identifying the provenance of raw glass is of great help in establishing trade routes and, consequently, the contacts that existed between different towns.[19]

A second natron sub-group characterized by low Ca, Mg, Ti, Fe and Al contents and high Na content includes the two yellow tesserae Gi1a and b, one blue A1 as well as the gold leaf tessera Au1s. This type of glass is characterized by the use of antimony in association with manganese as a decolourant in the production of clear glass.[20]

The analysis of the orange tesserae reveals that the chemical composition is comparable to those of coeval mosaics in Rome and Ravenna. In contrast, the composition of the red tesserae differs from the Roman ones in the presence of high concentrations of tin and zinc (generally absent or less than 0.1% in Roman tesserae). Compositional similarities found in a red tessera of the Neonian Baptistery in Ravenna,[21] suggest that both the Milanese and Ravenna mosaic tesserae, or at least a proportion of them, were made at the same site. It is interesting to observe that the red

colour was widely used in Milanese mosaics, as if it was a readily available material.[22] However, it must be remembered that analyses of the mosaics in the Neonian Baptistery reveal a complex situation, in which important compositional differences indicate different provenances, and the presence of reused tesserae remains a possibility.[23] This issue deserves further investigation and represents another peculiarity of the Milanese tesserae in comparison with contemporary Roman ones.

Opacifiers

In this complex picture the most important innovative feature of the tesserae of the mosaics of San Giovanni alle Fonti is the use of tin as an opacifier and clarifier as an alternative to antimony. Most tesserae were opacified with tin oxide, except for some blue ones opacified with calcium antimonate. As mentioned before, tin is a novelty among the opacifiers used in mosaic glass tesserae. In contemporary Roman examples, antimony was used following a century-long tradition that would continue in later ages. In contrast, some of the tesserae in Ravenna were opacified with calcium antimonate, while calcium phosphate (bone ash) was used in others. This is a new technique that probably originated from the Byzantine Middle East.[24] In a number of blue and green tesserae opacified with tin, antimony dissolved in the glass or in the form of sporadic antimonate crystals was also found. The coexistence of tin and antimony in this kind of tesserae has no technological explanation. It is reasonable to suppose that they were prepared by remelting earlier glass containing antimony, which was then opacified by adding tin oxide. The use of tin in the tesserae of San Giovanni alle Fonti seems to indicate an influence of north European glass technology.[25] Unlike later opaque glass in which tin was introduced as a lead-tin calx, no lead was detected in these tesserae. It is likely that this was still an imperfect technique (the presence of lead helps the dispersion of the cassiterite crystals in the melt) that explains the heterogeneity of these tesserae and the presence of tin crystal aggregates. Because this technique had never been adopted before for mosaic glass tesserae, the analyses exclude the possibility that they are reused materials.

Gold leaf tesserae

The use in the same mosaic of gold leaf tesserae made from a transparent colourless glass or a yellow-green glass seems to have been a deliberate choice intended to give the gold leaf (pure gold in both cases) a different luminosity: a silvery effect on a colourless support and a warmer one on a yellow-green glass. In fact with the gold leaf being beaten into thin layers and partially torn, the colour of the support glass affects the hue of the tessera. This optical effect has also been observed in experimental tests on modern cakes. The supposed deliberate choice is supported also by the presence of both types of gold leaf tesserae, which can be distinguished by the naked eye, in all the Milanese examples examined up to now. This mixture can be observed in the gold background of the mosaics in the niches of Sant'Aquilino and in the gold sky of the vault of San Vittore. In these buildings, gold leaf tesserae seem to be mixed according to an aesthetic principle of imparting movement and avoiding excessive flattening of the background, and also by arranging the tesserae in an uneven way. One can also observe in the religious buildings of Ravenna the use of different types of gold, with the support made of a stronger or lighter coloured glass.[26] It has not so far been ascertained whether the two kinds of gold leaf tesserae used in Milan and in Ravenna were imported from different workshops, or locally produced with different types of glass.

Though it has been poorly studied, the use of different types of mosaic gold seems to have been a widespread practice in the Late Antique and Byzantine periods, to enhance both the gleam and brilliance so persistently pursued by contemporary aesthetic principles, mixing beauty and ostentation.[27]

Conclusion

The analyses of the glass tesserae belonging to the 5th to 6th century mosaics of the Baptistery of San Giovanni alle Fonti in Milan provide a complex picture that suggests more than one possible provenance for these materials.

Some tesserae are similar to those of the Roman and Early Christian mosaics in Rome. A characteristic of these tesserae is the use of natron type glass opacified with calcium antimonate. Some of the blue tesserae from Milan as well as some green ones fall into this group. The orange tesserae also belong to the Roman glassmaking tradition. It is not possible to establish whether the cakes were imported and then cut in the yard, or the tesserae were reused materials from previously dismantled mosaics, such as those from Milan. It is possible that the mosaic tesserae used in the imperial buildings in Milan had been made according to Roman glass making traditions. For historical reasons, trading contacts between Gothic Milan and Rome in this period are improbable, although they cannot be completely excluded.

The red tesserae from the Baptistery of San Giovanni show some peculiarities, such as unusual tin and zinc concentrations that can be also found in some of the red tesserae of the Neonian Baptistery in Ravenna. Further investigation is necessary to confirm these features and ascertain production areas.

The purple-brown tesserae coloured with flakes of iron oxide are a unique example of this technique. The remaining coloured tesserae were made with natron type glass, with tin-based white (tin oxide) and yellow (lead stannate) pigments. While lead stannate was commonly used in Late Roman and Byzantine glass making technology,[28] no evidence has been found for the use of white tin oxide. In contrast, tin oxide was already used in northern Europe for the production of opaque glass artefacts, such as enamels and glass beads, between the end of the 1st century BC and the early 1st century AD. It also appears in some Merovingian glassware (5th to 6th century). With regards to the production of glass tesserae, the mosaic in San Giovanni alle Fonti seems to be the earliest example of this technique. It is interesting to remember that the glass used for these tin opacified tesserae was most probably remelted glass cullet.

The divergences from the Roman glass making tradition might be associated with the presence of the Goths in Milan between the 5th and 6th centuries. It was the intention of the

newcomers to maintain a cultural and, at first, a political continuity with Constantinople, although their presence inevitably introduced new elements to the already existing practices. To support this hypothesis, it would be necessary to extend the analyses to glass mosaic tesserae from extant mosaics of the Gothic period in northern Italy.[29] On the other hand, it is not unlikely that barbarian populations with metallurgical skills may have introduced novel details in glass making. The abundance of yellow colours, peculiar red colours and the use of tin are all possible indicators of this. These results reveal a complex picture for the 5th to 6th century mosaics of San Giovanni alle Fonti, and substantiate the hypothesis of a local production centre which has previously been formulated only on the basis of the presence of a large number of buildings with mosaics in Milan.

Acknowledgements

Professor Silvia Lusuardi Siena (Università Cattolica del Sacro Cuore, Milan) is kindly acknowledged here. Her interest and curiosity allowed the analyses to be granted financial support in the context of the 'Piazza Duomo prima del Duomo' project which she coordinates. The authors would also like to thank Anna Ceresa Mori (Soprintendenza per i beni archeologici della Lombardia) for authorizing the present study.

Notes

1 This paper is the result of close collaboration between the authors. The analyses have been carried out by A. Conventi and M. Verità and the text has been edited by E. Neri.

2 For a summary on the historical-archaeological background see A. Salvioni (ed.), *Milano capitale dell'impero romano (286–402 d.C.)* (exh. cat., Milan, 24 January–22 April 1990), Milan, 1990; G. Sena Chiesa and E.A. Arslan (eds), *Felix temporis reparatio* (Atti del Convegno archeologico internazionale *Milano capitale dell'impero romano*, Milan, 8–11 March 1990), Milan, 1992; D. Caporusso, *Scavi MM3. Ricerche di archeologia urbana a Milano durante la costruzione della linea 3 della metropolitana*, Milan, 1991; D. Caporusso, M.T. Donati, S. Masseroli and T. Tibiletti, *Immagini di Mediolanum. Archeologia e storia di Milano dal V sec. a.C. al V sec. d.C.*, Milan, 2007; D. Caporusso and A. Ceresa Mori, 'C'era una volta Mediolanum', *Archeo. Attualità dal Passato* 307 (2010), 70–105.

3 S. Lusuardi Siena, 'Committenza laica ed ecclesiastica in Italia settentrionale nel regno goto', in *Committenti e produzione artistico-letteraria nell'alto Medioevo occidentale. Atti delle Settimane di Studio 4–10 Aprile* (Settimane de Studi de Centro Italiano di Studi sull'Alto Medioevo 39), Spoleto, 1992, 199–242; E. Neri, S. Lusuardi Siena and M. Verità, 'La produzione di tessellata vitrea trado antichi e altomedievali a Milano: un progetto archeologico-archeometrico', *AISCOM* XVI, Tivoli, 2011, 293–306.

4 M. Mendera, 'Produzione vitrea medievale in Italia e fabbricazione di tesserae musive', in E. Borsook, F. Gioffredi Superbi and G. Paliarulo (eds), *Medieval Mosaics: Light, Colour, Materials*, Milan, 2000, 97–138; J. Nordhagen, 'Mosaici di Sant'Aquilino: originali e rifacimenti', in C. Bertelli (ed.), *Il Millenio ambrosiano: Milano una capitale da Ambrogio ai Carolingi*, Milan, 1987, 162–7; C. Bertelli, 'Mosaici a Milano', in *Milano e i milanesi prima del Mille (VIII–X secolo). Atti del 10° Congresso Internazionale di Studi sull'Alto Medioevo, Milan 1983*, Spoleto, 1986, 333–49.

5 The excavation data was published in S. Lusuardi Siena, B. Bruno, L. Villa *et al.*, 'Le nuove indagini archeologiche nell'area del Duomo', in M. Rizzi (ed.), *La cittá e la sua memoria. Milano e la tradizione di Sant'Ambrogio*, Milan, 1997, 40–52; an overview of the episcopal building complex is in S. Lusuardi Siena, *Piazza Duomo prima del Duomo*, Milan, 2009, and. S. Lusuardi Siena and F. Sacchi, 'Gli edifici battesimali di Milano e di Albenga', in M. Marcenaro (ed.), *Atti del Convegno "Albenga città episcopale. Tempi e dinamiche della cristianizzazione tra Liguria di Ponente e Provenza" (Albenga, 21–3 settembre 2006)*, Albenga, 2007, 677–702; the discovery context of the decorations is detailed in S. Lusuardi Siena and F. Sacchi, 'Per un riesame dei sectilia parietali paleocristiani del Battistero di S. Giovanni alle Fonti a Milano', *AISCOM* X (2004), 81–96.

6 Ennodio, *Carmina*, 2, 56 (F. Vogel (ed.), Berlin, 1885, 157); for the English translation see S.A.H. Kennell, *Magnus Felix Ennodius: a Gentleman of the Church*, Ann Arbor, 2000.

7 Only vitreous materials were used. Despite the wide chromatic palette, stone was not used.

8 According to the reconstruction suggested in Lusuardi Siena and Sacchi 2007 (n. 5), the area of the dome should have been 108.73m^2. The basins of each circular niche have been estimated at 5.07m^2 and the lunette and soffit of the arch 6.6m^2.

9 M. Verità, 'Technology and deterioration of vitreous mosaic tesserae', *Reviews in Conservation* 1 (2000), 65–76.

10 The microprobe was equipped with three wavelength dispersive spectrometers (PET, LiF and TAP crystals). Twenty elements were quantified: X-ray Kα lines were analyzed except for Pb and Bi (Mα lines), Sb, As and Sn (Lα lines). Operating conditions were: accelerating potential 15kV, beam current 20 nA (major and minor components) or 100 nA (trace elements) respectively. A 40 x 50μm scanning electron beam and limited counting time (10s for major and minor elements, 20 to 30s for traces) were employed to ensure that no significant alkali drift (ion migration) occurred during the irradiation. The net X-ray intensities (peak minus background) were quantified by means of a PAP correction programme supplied by CAMECA.

11 According to Pliny (*Nat. Hist.* XXXI.107), Macedonia, Media and Thrace were also rich in natron. E. Dotsika, Y. Maniatis and D. Ignatiadou, 'A natron source for glass making in Greece? Preliminary results', in *Proceedings of the 4th Symposium of the Hellenic Society for Archaeometry, National Hellenic Research Foundation, Athens 28–31 May 2003*, Oxford, 2003, 359–61, have identified possible natron sources in Macedonia.

12 M. Vallotto and M. Verità, 'Glasses from Pompeii and Herculaneum and the sands of the River Belus and Volturno', in J. Renn and G. Castagnetti (eds), *Homo Faber: Studies on Nature, Technology, and Science at the time of Pompeii*, Munich, 2000, 63–74.

13 I.C. Freestone, 'The provenance of ancient glass through compositional analysis', in P.B. Vandiver, J.L. Mass and A. Murray (eds), *Materials Issues in Art and Archaeology VII* (Mater. Res. Soc. Symp. Proc. 852), Warrendale, PA, 2005, 008.1–008.14.

14 I.C. Freestone, C.P. Stapleton and V. Rigby, 'The production of red glass and enamel in the Late Iron Age, Roman and Byzantine periods', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Exeter, 2003, 142–54.

15 M. Verità, 'Analyses of early enamelled Venetian glass: a comparison with Islamic glass', in R. Ward (ed.), *Gilded and Enamelled Glass from the Middle East*, London, 1998, 129–34; I.C. Freestone and C.P. Stapleton, 'Composition and technology of Islamic enamelled glass of the thirteenth and fourteenth centuries', in Ward ibid., 122–8.

16 I.C. Freestone, S. Wolf and M. Thirlwall, 'The production of HIMT glass: elemental and isotopic evidence', in *Annales du 16e Congrès de l'Association Internationale pour l'Histoire du Verre, London 2003*, Nottingham, 2005, 153–7, suggest the use of metallurgical by-products (from silver-refining in particular) to assist with the preparation of the red glass; B. Gratuze, D. Foy, J. Lancelot and F. Tereygeol, 'Les "lissoirs" carolingiens en verre au plomb: mise en évidence de la valorisation des scories issues du traitement des galènes argentifères de Melle (Deux-Sèvres)', in D. Foy and M.-D. Nenna (eds), *Echange et commerce du verre dans le monde antique* (Actes du colloque de l'Association Française pour l'archéologie du verre, Aix en Provence-Marseille, 7–9 June 2001), Montagnac, 2003, 101–7, suggest the use of slags to colour the red glass of the *lissoirs* of the Carolingian period.

17 B. Gratuze, I. Soulier, J.N. Barrandon and D. Foy, 'De l'origine du cobalt dans le verres', *Revue d'Archéometrie* 16 (1992), 97–108.

18 Freestone (n. 13).

19 It is interesting to observe that C. Fiori, M. Vandini and V. Mazzotti identified a lower percentage of HIMT type glass in the mosaics in San Vitale in comparison with the amount found in the Milanese mosaics (C. Fiori, M. Vandini and V. Mazzotti, *I colori del vetro antico. Il vetro musivo bizantino,* Vicenza, 2004).

20 C. Jackson, 'Making colourless glass in the Roman period', *Archaeometry* 47 (2005), 763–80.

21 M. Verità, 'Glass mosaic tesserae of the Neonian Baptistry in Ravenna: nature, origin, weathering causes and processes', *Proceedings of the Conference: Ravenna Musiva, 22–4 October 2009*, 2010, 89–103.

22 Red hues in Milanese mosaics are most prominent in the niches of Sant'Aquilino (4th to 5th century), the wall sectilia in Sant'Ambrogio, and in San Lorenzo.

23 See Verità (n. 21).

24 F. Marii and T. Rehren, 'Archaeological coloured glass cakes and tesserae from Petra church', in K. Janssens, P. Degryse, P. Cosyns, J. Caen and L. Van't dack (eds), *Proceedings of the 17th AIHV Congress, 2006, Antwerp*, Antwerp, 2009, 295–300; Verità (n. 21); M.T. Wypyski, 'Technical analysis of glass mosaic tesserae from Amorium', *Dumbarton Oaks Papers* 59 (2005), 183–92; A. Silvestri, S. Tonietto, G. Molin and P. Guerriero, 'The palaeo-Christian glass mosaic of St. Prosdocimus (Padova, Italy): archaeometric characterisation of tesserae with antimony- or phosphorus-based opacifiers', *Journal of Archaeological Science* 39 (2012), 2177–90.

25 M. Tite, T. Pradell and A. Shortland, 'Discovery, production and use of tin-based opacifiers in glasses, enamels and glazes from the late Iron Age onwards: a reassessment', *Archaeometry* 50 (1) (2008), 67–84, supplies documentary evidence for the use of tin in England, France and Czechoslovakia in the 2nd to 1st century BC and in Scotland in the 1st to 2nd century AD. For the use of tin in the Merovingian world (5th to 6th century) see M. Heck and P. Hoffman, 'Coloured opaque glass beads of the Merovingians', *Archaeometry* 42 (2000), 341–57; P. Hoffmann, S. Bichlmeier, M. Heck, C. Theune and J. Callmer, 'Chemical composition of glass beads of the Merovingian period from graveyards in the Black Forest, Germany', *X-Ray Spectrometry* 29 (2000), 92–100.

26 Warmer green glass tesserae were used in the more important parts, such as the absidal basin and around the main figures: E. Carbonara, C. Muscolino and C. Tedeschi, 'La luce del mosaico: le tesserae d'oro di Ravenna. Tecniche di fabbricazione e utilizzo', *AISCOM* VI (1999), 709–18.

27 For the role of light in Byzantine art and particularly in mosaics, see L. James, *Light and Colour in Byzantine Art*, Oxford, 1996.

28 R.H. Brill, *Chemical Analyses of Early Glasses: Volume 1 (tables) and 2 (catalogue)*, Corning, 1999; M. Verità, M. Maggetti, L. Saguì, and P. Santopadre, 'Colors of Roman glass: an investigation of the yellow *sectilia* in the Gorga Collection', *Journal of Glass Studies*, accepted for publication in issue 55, 2013.

29 However the glass tesserae of the mausoleum of the prefect Opilio in Santa Giustina in Padua (5th to 6th century) are opacified with antimoniate or calcium phosphate (Silvestri *et al.* [n. 24]). These tesserae are similar to tesserae from Ravenna (Verità [n. 21]).

Chapter 2
Glass Tesserae from the Petra Church

Fatma Marii

Historical background

The period from the 4th to the mid-7th century is identified in the history of the Near East as 'Byzantine', and is variously referred to as 'Late Roman' or 'Late Antique' in other geographic regions.[1] In this paper, the term 'Byzantine' is used, following the refined period division of Levantine archaeologists.

Petra, located in southern Jordan, was famous for being the capital of the Nabataean Kingdom, and functioned as its administrative and economic centre from the 1st century BC to the 1st century AD.[2] Petra survived well into the Byzantine period, although perhaps on a less prosperous level than in the Nabataean period. The archive of papyrus scrolls, including Greek documents found in a room adjacent to the northeast corner of the Petra Church, tells us more about the population and the agricultural life of Petra, which could have played a major role at that time, and shows that Petra remained a viable city with a functioning hinterland throughout the 6th century. This archive does not preserve information concerning trade or trading patterns.[3] However, these historical sources inform us that the local administration in Petra was still fully functional and that the city maintained economic and administrative activities in the middle of the 6th century.[4]

Petra Church project

In 1973, the late Kenneth Russell saw the outline of an apse on a slope north of the Colonnaded Street in Petra. In 1990 he formally recorded the site and estimated that it was a large Byzantine church, based on the visible remains of an apse and quantities of small glass tesserae which were found on the surface indicating that the church must have been richly decorated with mosaics.[5] The discovery of this Byzantine ecclesiastical complex was significant for understanding the Byzantine period in Petra. The archaeological excavations of the church between 1992 and 1996 were supported by the American Centre of Oriental Research (ACOR), in co-operation with the Ministry of Tourism and the Department of Antiquities of Jordan.[6]

The Petra Church is a triple-apsed basilica (**Pl. 1**). The nave is divided from the aisles by two east–west rows of eight columns. At the east end of the north and south aisles are semi-circular apses, while the nave terminates in an elevated bema and a larger semi-circular apse. The church proper is about 25m long by 16m wide. An atrium court is located to the west of the church. The walls of the church are preserved in some places to a height of 3.5m. The interior faces of some walls are coated with patches of well-preserved white plaster. Some capitals, column drums and other architectural elements had been reused in the walls.

The north and south aisles are paved with mosaic floors, the style of which is dated to the early 6th century. They are composed of multicoloured tesserae, and both have depictions of human figures, birds and animals in geometric frames. The two side apses are also paved with mosaics but in a simple yellow and white checkerboard pattern. The nave, bema and central apse are paved with an *opus sectile* pavement of white marble and purple sandstone.[7]

The atrium court, located to the west of the church, takes the form of an open-air courtyard with sandstone pavement,

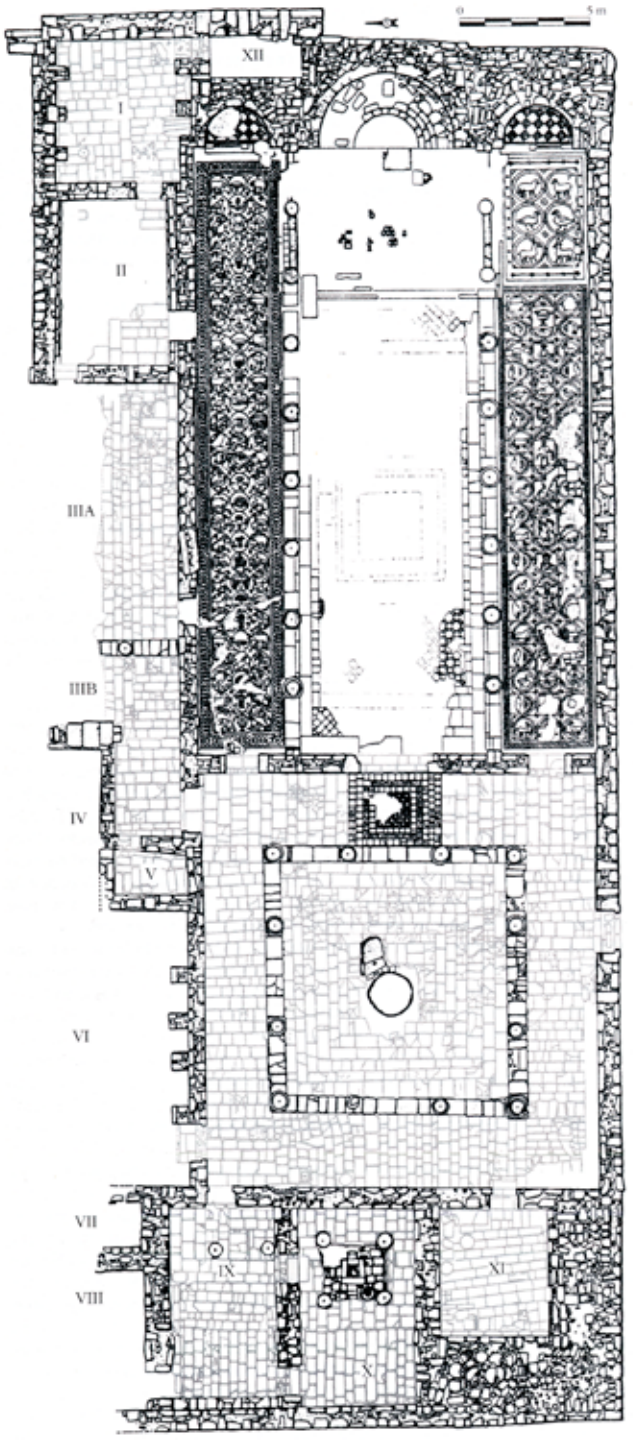


Plate 1 Ground plan of the existing remains of the Petra Church

surrounded on all sides by a portico. Three doors lead into the church from the east side of the atrium. Two doors in the north wall of the church, and another door in the northeast corner of the atrium, lead to a series of rooms adjoining the church to the north.[8] On the western side of the atrium are three rooms: IX, X and XI. A baptistery with a cruciform font and a canopy over it, supported by four columns, is located in the eastern half of Room X.[9]

The history of the Petra Church complex is divided into thirteen phases based on the analysis of the stratigraphic sequences, architectural studies and the examination of the material remains.[10] Phases I and II, dating from the 1st century BC until the mid-4th century, that is the Nabataean to Late Roman periods, was most probably ended by the earthquake of AD 363. Early Byzantine residential remains were found in Phase III, which is dated from AD 363 to around the mid-5th century or later. The main church complex started in Phase IV as well as the row of Rooms IX, X and XI to the west of the church, which are dated to around the mid-5th or early 6th century. Phases V and VI during the 6th century saw the ecclesiastical occupation and use of the church in the Late Byzantine period. Phase VII, at the end of the 6th century or the beginning of the 7th century, saw the beginning of renovation and storage activities in the church which led to the stripping out of some of its liturgical furnishing. The destruction by fire, which caused its abandonment at the beginning of the 7th century, happened in Phase VIII. Phase IX, from around the end of the 6th century to the mid-7th century, saw the end of occupation of the church, although there was still some domestic occupation, primarily in Rooms IX and XI. The gutted church was selectively stripped of useful material; marble paving, wall mosaic tesserae and glass were collected for reuse or re-melting. Cakes of glass paste presumably made of re-melted multicoloured components (glass fragments and/or tesserae) were found in Room IX. In the middle of the 7th century the church suffered a partial collapse of its walls and columns probably as the result of an earthquake. Post-earthquake activities, structural destruction and natural deposition are all represented in Phases XI, XII and XIII, which started in the Islamic period from the late 7th century onwards.[11]

Glass finds in the Petra church

Numerous glass fragments were unearthed during the excavation of the Petra Church, resulting in a massive assemblage from the site, but with no evidence of any furnace or workshops existing at the location. The glassware from the Petra Church falls into three categories. The first is composed of a large number of transparent glass objects including standard liturgical glass lamps, window fragments and tableware vessels. The second group consists of thousands of scattered glass tesserae of various colours and shades, which will be the focus of this paper. The third group includes the glass cakes which are tentatively considered as unfinished products of a glass re-melting process.

Zbigniew Fiema has provided two different possible explanations for the presence of the glass cakes together with the loose tesserae and broken glass fragments in Room IX of the church.[12] The hypotheses infer that they could have been either the remains of tesserae production or the products of re-melting tesserae, broken vessels and lamp fragments as raw materials ready for recycling. In the first case, the glass cakes could be considered as an easily transportable material for the local or on-site production of wall mosaic tesserae. This is indicated by the presence of a few cakes with strong colours and straight surfaces, the latter being the result of cutting. If these cakes survived from Phases IV, V and VI at the time of the production of tesserae for new mosaics, then they are likely to have been raw glass used in the process of making tesserae.[13]

In addition to the glass cakes found in Room IX, there were substantial quantities of broken glass fragments and

Plate 2 Examples of the figures and designs found in the wall mosaic fragments excavated from the Petra Church

heavy concentrations of stone and glass mosaic tesserae completely mixed together. This heap appears to be unsystematically collected material dumped in preparation for further sorting rather than two separate components brought together for immediate use. Among these tens of thousands of loose tesserae, not one mortar lump with tesserae still embedded in it was found. However, some tesserae display traces of mortar bedding on their surfaces. Therefore, these must have already been separated from their original context rather than being the result of contemporary cutting into cubes in preparation for the installation of new wall mosaics. Thus the deposits in Room IX represent an advanced stage of collection in which tesserae already removed from their bedding were probably collected to sort the glass from the stone pieces. Many of the hundreds of wall mosaic mortar lumps found during the excavations of the interior of the church did not contain any tesserae. That may be due to lack of preservation, but could equally represent the discarding of mortar bedding lumps after the tesserae had been pulled out.[14]

Alternatively, Fiema considered the possibility that the cakes and tesserae found in Room IX, as well as the other heaps of tesserae found inside the complex, could belong to the poorly understood Phase VII, or even to the last ecclesiastical Phase VI.[15] The cakes could have been brought here during these phases as a raw material to be cut into mosaic tesserae and used in the repairs of old mosaics or the installation of new ones. At the same time, old mosaics could have been in the process of being dismantled judging from the traces of mortar on many tesserae. Afterwards the collected material was stored for sorting out for further use or re-melting. A more extreme interpretation also fits the available evidence, namely that the wall mosaics were being dismantled in Phase VII and the tesserae were collected for re-melting as with the pending conversion of the church into a storage area, the building was to be permanently deprived of its wall decoration.[16]

Collection points of glass tesserae were also found inside the church itself. Huge concentrations of loose tesserae were uncovered outside right in front of the apse. Tesserae, numbering tens of thousands, were found in irregular heaps. A concentration of tesserae was also discovered against the northern wall of the church.[17] These finds allowed Fiema to continue with his assumption that the loose tesserae were probably collected inside the church for a preliminary sorting which involved the initial separation of the tesserae cubes from their mortar bedding.[18] Later, the piles of tesserae were presumably transported to Room IX. The process of separation was apparently unfinished; the material was abandoned for unknown reasons and covered by subsequent re-deposition and naturally formed strata.

Glass tesserae in the Petra church

The tesserae were used to furnish the Petra Church with floor mosaics in both the north and south aisles of the building. They were also used in the wall mosaics which archaeologists have suggested were installed in the semi-domes of the central apse and in the lateral apses, over the arches in the front of all three apses (north, central and south), and on the clerestory above the colonnades on the northern and southern sides facing the nave. This installation occurred during Phase V, between the early and mid-6th century.[19] Many wall mosaic fragments, which are a group of tesserae embedded in their mortar bedding, were found during excavations. Estimating how many square metres the tesserae covered in the church was not possible because the density of cubic tesserae varies according to the design or the figures that were depicted (**Pl. 2**). For example, at the borders of the wall mosaic there were at least 65 tesserae per decimetre square (dm^2); for the bluish parts interpreted as robes and for floral fragments the average was 120–50 tesserae per square decimetre. The faces (regardless if they are animals or human figures) feature the most tesserae per decimetre square, which can reach 360 per decimetre square in one fragment. This number exceeded by far the maximum for any floor mosaic from the church, which has a maximum of 220 tesserae per decimetre square, that being found only in the head of a man,[20] as these tesserae are smaller in size than the others.

Vast quantities of loose mosaic tesserae of different materials were excavated from the church: these included stone, ceramic and glass tesserae scattered throughout the entire church. Unfortunately the exact quantity and total weight of the glass tesserae from the church could not be measured precisely since the loose glass tesserae were always found mixed with loose stone tesserae. After the excavation

Plate 3a–b: (left) transparent support gold tessera; (right) photomicrography under plain polarized light clearly showing the rarity of bubbles and the layer of gold sheet between the two transparent glass layers (magnification 100X)

and the analytical work of the Petra Church project was completed, all the loose tesserae were returned to the church and re-buried *in situ*, with the result that a precise calculation of the weight and proportion of the glass tesserae was no longer possible. However, a relative figure of the total weight of the tesserae can be estimated through the average weight per tessera (measured from the samples selected for the analysis), which is around 1.5g. Since archaeologists recorded that hundreds of thousands of loose tesserae have been excavated from the complex,[21] the total weight of all the tesserae could be roughly estimated to be around 150kg, noting that this figure includes the stone tesserae as well.

The discovery of large quantities of glass tesserae with a variety of colours in the Petra Church excavation is not an uncommon feature for a Byzantine church. Glass tesserae for wall mosaics were frequently found in churches and large secular buildings of the 5th to the 7th century, as the assemblages from the other Jordanian sites of Jerash, Samaria, and Khirbet al Kerak demonstrate.[22] Surviving examples of wall mosaics were found in the Church of Hagia Sophia in Constantinople, and at the Monastery of St Catherine in Sinai, the wall mosaic of the latter dating to the 6th century. In these two examples, the figures' designs of colourful glass and stone tesserae are executed against a background of gold tesserae.[23] This is similar to the surviving examples of wall mosaic fragments from the Petra Church. A few sections of the mosaic fragments from the church show human figures against a background of mosaic cubes with gold leaf.[24] The technique used to produce the gold tesserae sheet was to lay very fine gold leaf over a sheet of transparent glass and then cover it with another thin layer of transparent glass. These were then fused together to produce a 'sandwich' which gives the brilliant gold appearance (**Pl. 3a–b**).[25]

During the excavation of the Petra Church archaeologists and conservators classified the glass tesserae into 32 different groups based on their colours and hues.[26] The main colours of the tesserae that were classified are: blue-green, green-blue, blue, purple, yellow, black, white, red, ochre and a 'sandwiched' gold leaf referred to above.

Methods of analysis

For the analytical work one sample from each of the 32 representative colours was selected randomly, meaning that each tessera represents one colour rather than its excavated location. The samples were prepared in epoxy resin blocks, ground and polished. The sample blocks were then vacuum-carbon coated to ensure the electrical conductivity of their surface which is necessary for traditional scanning electron microscope and electron probe microanalysis, which deflects the primary electron beam away from the sample surface to avoid charging.

Tesserae samples were examined by reflected light microscopy allowing the observation of the textural characteristics of the sample, using plain and cross polarized light to identify the distribution of bubbles and inclusions in the different colours of each individual sample.

Optical microscopy examination of the samples revealed inclusions and crystals that required further investigation. Samples were analyzed using scanning electron microscopy-energy dispersive spectrometry (SEM-EDX), which allows us to recognize the very fine detail of these inclusions in the glass materials. These were distinguished by differences in the intensities of the backscattered electrons (BSE). That BSE imaging shows differences in composition as variations in brightness and the heavier the elements present the brighter the image. SEM-EDX is commonly used for examining opaque glasses allowing the crystals which cause the opacification to be photographed and analyzed separately.[27] The SEM-EDX used to analyse these tesserae samples was a Hitachi S-570 scanning electron microscope, combined with an Oxford Instruments ISIS energy dispersive spectrometry (EDX) package, operated with a beam intensity of 20kV for all the analyses. Calibration of the machine was carried out using a cobalt standard before each analysis and at 30 minute intervals during analysis; this procedure adjusted the software to any fluctuations in the instrument's electrical current. All X-ray analyses using ISIS were executed using 30–40% dead time; the software produced a spectrum, and elemental peaks were labelled and line-overlap problems noted. Quantitative results were normalized to 100% after allowing for stoichiometry which mathematically combines the elements present with oxygen.

A JEOL electron-probe super JXA-8600 with a wavelength dispersive spectrometer (WDX) was operated at 15 keV acceleration potential and a 60 nA beam current was used to identify the bulk chemical composition of these glass tesserae. This is helpful for indicating the type of glass and giving data for the bulk composition of the glass samples. Areas were analyzed at 800X magnification, covering approximately 280μm^2, on all parts of the glass samples but avoiding any inclusions, weathering and/or gas bubbles.

The quality of electron-probe microanalysis data depends on the accuracy, precision and the detection limits of the instrument. All significant values are presented as determined by the detection level of the microprobe and the computer software calculations. Instrument calibration and data quality were controlled by checking the accuracy and precision of the instrument. The microprobe is calibrated with pure metals and simple component standards. The calibration is then tested for accuracy by analyzing reference glasses with certified compositions. This was achieved by repeated analyses of reference glass material developed by the Corning Museum of Glass (standard B), which is of the soda-lime glass type.[28] This was analyzed in the microprobe in parallel to a comparison with the glass samples of

ST-Corning B	SiO_2 wt%	Na_2O wt%	CaO wt%	P_2O_5 wt%	K_2O wt%	MgO wt%	Al_2O_3 wt%	Fe_2O_3 wt%	TiO_2 wt%	MnO wt%	Sb_2O_5 wt%	CuO wt%	CoO wt%	PbO wt%	ZnO wt%	SnO_2 wt%	BaO wt%
Corning B measured	61.78	17.03	8.74	0.78	1.03	0.96	4.18	0.32	0.10	0.24	0.41	2.67	0.04	0.44	0.17	0.02	0.09
Corning B certified	62.30	17.00	8.56	0.82	1.00	1.03	4.36	0.34	0.09	0.25	0.46	2.66	0.05	0.61	0.19	0.04	0.12
Different absolute	0.52	0.03	0.18	0.04	0.03	0.07	0.18	0.02	0.01	0.01	0.05	0.01	0.01	0.17	0.02	0.02	0.03
Different relative %	0.83	0.15	2.16	4.45	2.61	6.40	4.20	6.30	10.77	2.11	10.32	0.20	11.15	28.58	11.66	54.84	27.16
Standard deviation	0.59	0.41	0.18	0.07	0.05	0.07	0.23	0.03	0.02	0.03	0.06	0.09	0.02	0.05	0.04	0.02	0.02

Table 1 Comparison of recommended and measured oxide concentrations for Corning B glass (data published by Brill 1999)

unknown composition studied for this paper. The averages for each element oxide were indicated and compared to the values given by the standard reference material sources, with the absolute and relative differences determined. The reliability of the microprobe data is generally good, with some slight systematic errors affecting the accuracy of the instrument. The averages of the element oxides in **Table 1** show close values to the relevant certified given values. This can be seen in the absolute differences for the oxides, which range between 0.0 and 0.5 weight per cent (wt%). Therefore, the data produced by this method can be considered fully reliable and suitable for general comparison with the quantitative analyses of other glass materials reported in the literature.

Results

The 32 glass tesserae were examined by microscopy and analyzed for their chemical composition (**Table 2**). Sixteen of these samples were analyzed by Elisavet Markou in her MSc dissertation at the Institute of Archaeology (UCL).[29] In addition the whole range of coloured mosaic tesserae from the Petra Church has been analyzed by Cesare Fiori using X-ray fluorescence (XRF) analysis for the bulk glass, but without analyzing individual particles.[30] It is worth mentioning here that the identifying name of the tessera samples used in this text are the ones that were originally given during excavations.In **Table 2**, in the column of definitions, one should be aware that both the older definition, and the new one given by Fiori, is written in bold.[31]

Microscopic examination

The majority of the glass tesserae samples examined with the stereomicroscope showed a high density of gas bubbles and particles. The exceptions are the tesserae of yellow and green hues and the transparent support gold tessera that have a low density of bubbles (**Pl. 3a–b**).

Some tesserae contain particles that are rich in calcium (Ca) and phosphate (P) compounds.[32] These particles were detected in eight out of the 32 samples: green blue 6, violet 5, green light blue 7, green blue 8, blue 6, green blue 1, ochre brown and white.[33] Fiori re-defined the colour names of five of these samples, identifying them all as grey.[34] This could be explained by the fact that calcium phosphate particles combined with a high density of bubbles are the cause of the grey-white opacified colour range of these tesserae. Within the polished sample, several calcium phosphate-rich particles were unevenly distributed, showing a variety of sizes. These particles detected in the tesserae appear to be very porous, angular, and range in size from 100μm to 1mm (**Pl. 4a**).[35] The chemical analysis using SEM-EDX for several calcium phosphate-rich particles shows that the average lime content in these particles is around 50wt% and the phosphorus oxide (P_2O_5) content is around 41wt%. Sometimes crystals of calcium silicate surround these particles. There were other components (such as magnesia (MgO), silica (SiO_2), chlorine (Cl), etc.) detected with various percentages in these calcium phosphate inclusions.[36]

Manganese oxide (MnO)-rich particles were recorded in several of the glass mosaic tesserae (**Pl. 4b**).[37] These particles were recorded in the following samples: violet 5, violet white 6, green blue 8, blue 6 and violet dark 1. These particles are uneven in size, ranging between 1mm and around 200μm.[38] The chemical analysis using SEM-EDX for these manganese oxide particles shows that these particles are rich in manganese oxide with an average reaching to 73wt% of the total composition of these particles. Other compounds that have been detected in these particles are within various percentages and depend on the spot analysis that was measured.

The mosaic tesserae samples with a green-yellow range are distinguished by a significant distribution of lead (Pb) and tin (Sn) oxide-rich particles. Under optical microscopy examination these particles show as bright yellow and with backscattered electron microscope images they are seen as bright white.[39] These particles appear to be responsible for the opaque yellowish colour in these tesserae. This is similar to previously recorded yellowish opaque glass examined from different sites and dating from the 4th century onwards.[40] The chemical composition of these particles using SEM-EDX analysis was recorded from the yellow tessera sample and shows that on average the ratio between the lead and tin oxides in these particles is around 2:1.[41]

Chemical composition

The results of the electro-probe microanalysis of the glass mosaic tessera samples are presented in **Table 2**. This table presents the seven base glass oxides, silica (SiO_2), soda

Table 2 presents an image of the tesserae with their old and new definitions and the chemical composition of glass mosaic tesserae from the Petra Church using EPMA. The components are given as averages in weight percent. (*) These seven oxides are reduced then normalized to 100%, while the other oxides are presented as measured (bd. = below detection limits)

Petra Church Tesserae EPMA data			SiO_2*	Na_2O*	CaO*	K_2O*	MgO*	Al_2O_3*	Fe_2O_3*	P_2O_5	TiO_2	MnO	CuO	PbO	ZnO	SnO_2	SO_3	Cl	Total as measured
no.	image	definition	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
1		Green Blue 4 **Dark Green**	70.0	14.6	10.1	0.89	0.80	3.14	0.51	0.26	0.09	0.38	0.86	0.25	bd.	bd.	bd.	0.92	99.3
2		Green Blue 3 **Green**	70.6	14.6	9.51	0.86	0.77	3.12	0.58	0.21	0.07	0.29	0.91	0.16	bd.	bd.	0.07	0.95	100.4
3		Yellow Green **Green 3**	70.3	14.9	9.77	0.85	0.79	2.99	0.42	0.10	0.07	0.15	0.89	7.36	bd.	0.96	bd.	0.90	99.8
4		Yellow Green **Green Yellow 4**	70.4	14.9	9.61	0.85	0.81	3.02	0.43	0.09	0.08	0.33	0.46	7.38	bd.	0.55	bd.	0.90	99.3
5		Yellow Green **Green Yellow 5**	70.9	14.3	9.55	0.81	0.64	3.16	0.59	0.11	0.08	0.40	0.49	10.6	bd.	1.38	bd.	0.83	99.4
6		Yellow Green **Yellow Green 6**	70.6	14.8	9.44	0.83	0.80	3.09	0.42	0.13	0.07	0.24	bd.	10.4	bd.	1.38	bd.	0.89	99.1
7		Yellow **Yellow**	70.4	15.3	9.44	0.78	0.70	2.82	0.57	0.10	bd.	0.46	bd.	15.6	bd.	1.92	bd.	0.71	99.2
8		Dark Red **Red**	67.7	14.2	9.21	2.74	0.77	2.99	2.45	0.36	0.10	0.34	0.66	2.06	0.19	0.31	bd.	0.76	98.8
9		Green Blue 5 **Grey Light Blue**	70.1	14.9	9.68	0.91	0.82	3.04	0.48	0.16	0.07	0.47	bd.	bd.	bd.	bd.	0.07	0.97	99.6
10		Green Blue 6 **Grey**	70.1	14.8	9.83	0.90	0.83	3.06	0.43	0.15	0.08	0.53	bd.	bd.	bd.	bd.	bd.	0.89	99.1
11		Violet Light 5 **Grey**	70.1	14.6	9.90	0.85	0.75	3.12	0.63	0.47	0.08	0.83	bd.	bd.	bd.	bd.	0.08	0.90	96.7
12		Violet White 6 **Grey**	69.5	14.9	10.3	0.94	0.73	3.06	0.60	0.65	0.09	0.89	bd.	bd.	bd.	bd.	0.08	0.91	98.4
13		Green Light Blue 7 **Grey**	70.1	14.9	9.85	0.86	0.67	2.98	0.57	0.35	0.08	0.66	bd.	bd.	bd.	bd.	0.09	0.90	99.5
14		Green Blue 8 **Grey**	70.3	14.7	9.77	0.89	0.71	3.11	0.55	0.23	0.09	0.72	bd.	bd.	bd.	bd.	bd.	0.92	99.7

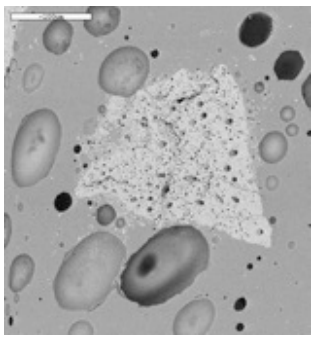
Petra Church Tesserae EPMA data			SiO_2*	Na_2O*	CaO*	K_2O*	MgO*	Al_2O_3*	Fe_2O_3*	P_2O_5	TiO_2	MnO	CuO	PbO	ZnO	SnO_2	SO_3	Cl	Total as measured
no.	image	definition	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
15		Blue 6 **Light Blue Grey**	70.4	14.8	9.81	0.81	0.63	2.91	0.60	0.38	0.09	0.47	bd.	bd.	bd.	bd.	0.08	0.93	99.3
16		Green Blue 2 **Turquoise**	70.2	14.8	9.75	0.90	0.80	3.09	0.45	0.16	0.08	0.36	1.08	0.22	bd.	bd.	bd.	0.94	99.3
17		Blue 5 **Light Blue**	69.9	14.9	9.84	0.89	0.83	3.12	0.52	0.22	0.09	0.48	bd.	bd.	bd.	bd.	0.07	0.99	98.9
18		Blue 2 **Light Blue**	70.1	14.6	9.49	0.87	0.83	3.19	0.92	0.11	0.08	0.30	bd.	0.43	bd.	bd.	0.07	0.99	100.1
19		Blue 1 **Blue**	70.3	14.5	9.59	0.89	0.83	3.19	0.71	0.11	0.08	0.42	0.14	0.43	bd.	bd.	0.07	0.98	99.3
20		Blue 3 **Blue**	70.5	14.4	9.51	0.83	0.82	3.16	0.74	0.12	0.08	0.38	bd.	0.41	bd.	bd.	0.06	0.96	99.5
21		Blue 4 **Blue**	70.5	14.5	9.53	0.85	0.85	3.19	0.66	0.13	0.09	0.35	bd.	0.34	bd.	bd.	bd.	0.98	98.7
22		Green Blue 1 **Blue Green**	71.0	14.6	9.40	0.84	0.69	2.91	0.52	0.11	0.08	0.40	1.14	0.17	bd.	bd.	0.08	0.91	98.6
23		Blue Green 1 **Blue Green**	69.9	15.3	9.67	0.88	0.83	3.05	0.44	0.10	0.08	0.33	1.75	4.03	0.26	0.56	bd.	0.94	99.9
24		Blue Green 2 **Blue Green**	70.7	14.5	9.58	0.85	0.63	3.09	0.58	0.11	0.07	0.56	0.63	6.03	0.01	0.78	bd.	0.87	98.3
25		Violet 2 **Light Violet**	70.3	14.8	9.65	0.86	0.84	3.12	0.41	0.10	0.09	0.82	0.01	bd.	bd.	bd.	bd.	0.98	100.0
26		Violet 4 **Light Violet**	69.8	14.9	9.97	0.90	0.85	3.09	0.48	0.39	0.09	0.82	bd.	bd.	bd.	bd.	0.07	0.96	99.1
27		Violet 3 **Violet**	70.4	14.7	9.62	0.87	0.82	3.12	0.49	0.22	0.09	0.79	bd.	bd.	bd.	bd.	0.07	0.94	99.2

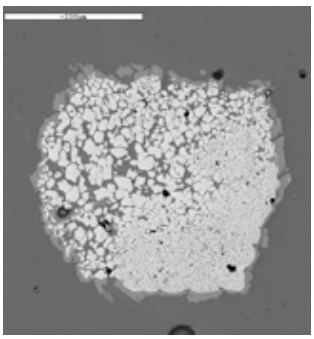
Petra Church Tesserae EPMA data			SiO_2*	Na_2O*	CaO*	K_2O*	MgO*	Al_2O_3*	Fe_2O_3*	P_2O_5	TiO_2	MnO	CuO	PbO	ZnO	SnO_2	SO_3	Cl	Total as measured
no.	image	definition	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
28		Dark Violet 1 **Violet**	70.1	15.1	9.57	0.89	0.70	3.06	0.62	0.16	0.09	0.92	bd.	bd.	bd.	bd.	0.09	0.92	99.0
29		Ochre Brown **Ochre Brown**	70.6	14.5	9.81	0.86	0.65	3.10	0.54	0.28	0.09	bd.	bd.	bd.	bd.	bd.	bd.	0.97	99.4
30		Black **Black**	66.6	13.2	9.38	1.93	0.62	3.03	5.28	0.28	0.10	0.21	bd.	bd.	bd.	bd.	0.07	0.84	97.9
31		Trans. s. Gold **Trans. s. Gold**	66.4	21.0	7.60	0.65	0.92	2.47	1.00	bd.	0.14	1.52	bd.	bd.	bd.	bd.	0.43	1.06	99.9
32		White **Light Grey**	70.2	14.5	10.3	0.82	0.73	2.82	0.59	0.73	0.08	0.83	bd.	bd.	bd.	bd.	0.09	0.85	96.6

(Na_2O), lime (CaO), potash (K_2O), magnesium oxide (MgO), iron oxide (Fe_2O_3) and alumina (Al_2O_3) normalized to 100%, yielding what is known as the reduced composition, together with the original values of the other analyzed oxides. Antimony oxide (Sb_2O_3) was sought but values were under detection limits in these samples. The original purpose behind calculating reduced compositions was to establish a basis for making better comparisons between compositional analyses of glasses, subtracting out any additive effect.[42]

The chemical analyses of these tesserae prove that all the glass compositions are soda-lime-silica natron-based glasses in general. **Figure 1** shows that there are outlier samples that have a different base glass composition than the majority of the other tesserae. These outliers are samples of red, black and transparent support gold tesserae. The diagram shows that the magnesia content in the majority of the glasses ranges from 0.62wt% to 0.85wt%. Meanwhile,

Plate 4a–b: (left) Backscattered electron photomicrographs of two particles found in the glass tesserae of the Petra Church: calcium phosphate particles detected in the white sample (scale bar in image is ~100µm) (4a); (right) manganese oxide inclusion violet dark1 sample (scale bar equal 200µm) (courtesy Markou [n. 29])





the potash content ranges from 0.75wt% to 0.94wt%. The outlier samples have higher contents of potash or magnesia. The transparent support gold has the highest magnesia content of 0.92wt%. The black and red tesserae have higher potash contents (1.93wt% and 2.74wt% respectively). The low ranges of potash and magnesia confirm that the base glass for all the tesserae falls into the category of soda-lime-silica glass that is characterized by low magnesia and potash contents. This was first identified by Sayre and Smith for Roman glass,[43] and then further studied by Danièle Foy *et al.*[44] and Ian Freestone *et al.* [45] for different glass samples from the Mediterranean area.

Figure 2 shows that the iron oxide content in the majority of the tesserae ranges between 0.41wt% and 0.74wt%. Tessera blue 2 is an exception with a higher level of iron oxide that reaches up to 0.92wt%, compared to the majority of the tesserae samples excluding the outliers. Meanwhile the outlier red, black and transparent support gold samples have higher iron oxide contents up to 2.45wt%, 5.28wt% and 1.00wt% respectively. The high level of iron oxide could be due to other additive colourants in these tesserae. The high percentage of iron oxide has been recorded previously in other red Roman and Byzantine glass mosaic tesserae, such as at San Marco in Venice[46] and Shikmona and Beit She'an in Israel.[47] It is well known that a high iron content is a characteristic of red opaque glasses.[48] The use of iron oxide to make very dark green to black glass has been seen in a number of samples from different sites and periods.[49] The most similar composition to the black tessera of the Petra Church are the black tesserae from Antioch.[50]

The amount of manganese oxide in the samples ranges from 0.15wt% to 0.92wt%. The exceptions are: the ochre brown sample, where manganese oxide is below the detection limit, and the transparent support gold sample,

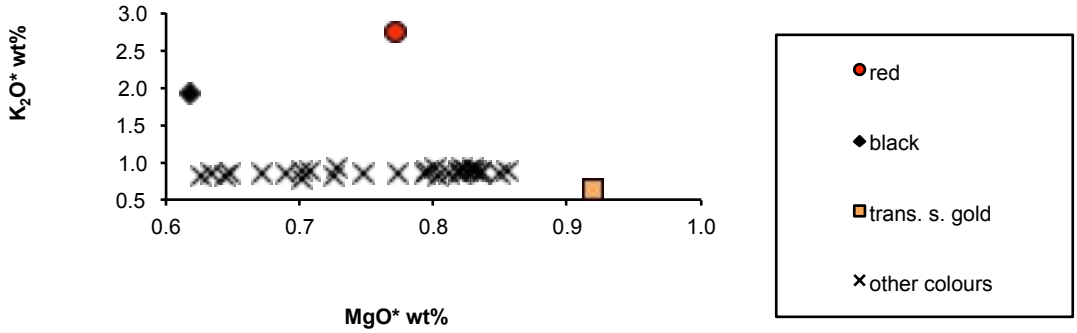


Figure 1 Scatter diagram showing the relationship between magnesia and potash contents (the reduced values) of the Petra Church glass mosaic tesserae

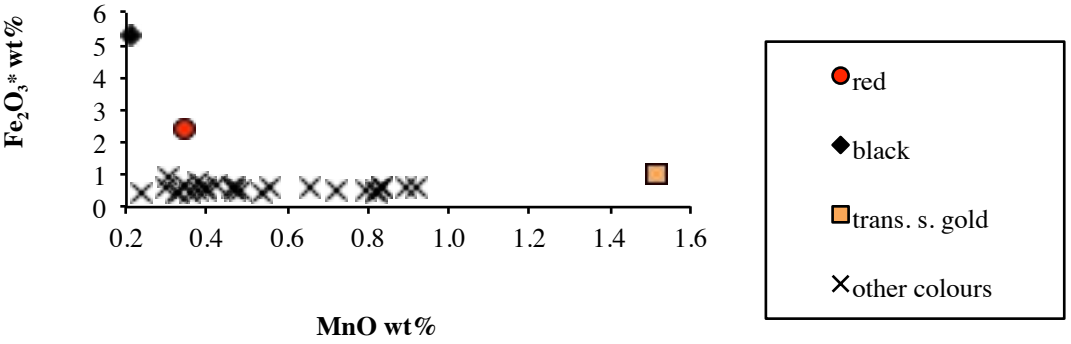


Figure 2 Scatter diagram showing the relationship between manganese oxide (as measured) and iron oxide (reduced value) contents of the Petra Church glass mosaic tesserae

which has the highest content of manganese oxide at 1.52wt%. This plot with iron oxide suggests that manganese oxide might have been added to this glass sample in order to neutralize the effect of the iron oxide which usually was found as an impurity in the sand or raw materials used for making ancient glass. The transparent support gold tessera is totally different in composition from the other glass tesserae. It is composed of a transparent colourless glass which was used as a support for the gold leaf.[51]

Phosphorus oxide was also detected in these mosaic tesserae. It can be seen from the results presented in **Table 2** that there is a positive correlation between the phosphorus oxide and lime contents. This could be the result of dissolving the calcium phosphate-rich particles that were mentioned earlier in the glass matrix. The phosphorus oxide content in the glass of these tesserae ranges from 0.09wt% to 0.73wt%. The two samples with the highest content of lime and phosphorus oxide that can be seen in the table are tesserae violet white 6 and white samples. The higher phosphorus oxide and lime contents in these two tesserae emphasizes the fact that the white-grey colour range of mosaic tesserae are the samples with the higher content of calcium phosphate-rich particles.

Copper oxide was found in some of the analyzed tesserae. The copper oxide content ranges between 0.01 wt% and 1.75wt% in these samples. This oxide can act as a major colourant for some tesserae and in others it can be a trace element added unintentionally with other colourants. In these tesserae copper oxide is associated with lead oxide, which was measured in some of the other analyzed samples as well. A turquoise blue tessera from San Marco contains a significant amount of lead and tin oxides and a much higher amount of copper oxide.[52]Analyses of red tesserae from Antioch showed traces of zinc and tin oxides which suggests that these oxides could come from a copper source.[53] Freestone *et al.* in their study of Byzantine tesserae from three churches – San Marco, Shikmona and Hosios Loukas – found that the red tesserae from the three sites were coloured by minute sub-micron copper rich droplets.[54] The level of copper oxide found in the Petra Church red glass is comparable to other Byzantine glass tesserae analyzed in Sardis in modern-day Turkey[55] and Beit She'an.[56]

The lead oxide content in the samples ranges between 0.16wt% and 0.43wt%, when it is associated with other colourants. However, in the green, yellow and blue colour-range tessera samples, the lead oxide content ranges between 2.06wt% and 15.6wt%. The tin oxide content found in 20 samples ranges between 0.31wt% and 1.92wt%; the lead-tin oxide compound is yellow and mixing with (blue) copper oxide produces various shades of green. Zinc oxide was detected in these samples as well, with an average of 0.15wt%. These lead-tin oxides have been recorded in previous studies as opacifiers in the green and yellow range glass mosaic tesserae from Shikmona and San Marco (Venice).[57] Fourteen opaque yellow glass tesserae from Beit She'an[58] were analyzed for their colours and it was found that lead-tin oxides associated with copper oxide were added to the base glass to produce various shades of greenish yellow through to green.

PCP mosaic tesserae	SiO_2* wt%	Na_2O* wt%	CaO* wt%	K_2O* wt%	MgO* wt%	Al_2O_3* wt%	Fe_2O_3* wt%	P_2O_5 wt%	TiO_2 wt%	MnO wt%	SO_3 wt%	Cl wt%
average (main group)	70.3	14.7	9.7	0.9	0.8	3.1	0.6	0.2	0.1	0.5	0.1	0.9
STDEV	0.3	0.2	0.2	0.0	0.1	0.1	0.1	0.2	0.0	0.2	0.0	0.1
(dark red)	67.7	14.2	9.2	2.7	0.8	3.0	2.4	0.4	0.1	0.3	0.1	0.8
(black)	66.6	13.2	9.4	1.9	0.6	3.0	5.3	0.3	0.1	0.2	0.1	0.8
(trans. s. gold)	66.4	21.0	7.6	0.6	0.9	2.5	1.0	0.1	0.1	1.5	0.4	1.1

Table 3 presents the average of the compounds that characterize the chemical composition of the glass mosaic tesserae of the Petra Church. Standard deviation of each oxide has been calculated. The composition of the outlier tesserae is presented. Oxides with (*) were reduced and normalized to 100%, while other elements are presented as measured

In general the Petra Church glass tesserae can be characterized as the following: of the 32 glass samples of mosaic tesserae analyzed for their chemical composition, 29 samples show a strong similarity in most of their base glass components. These samples are of natron-based glass with relatively low levels of magnesia and potash. The overall compositions of these glasses are associated with the Roman-Byzantine technological tradition in the Levant. The other three samples have different characteristics and could be of different origins. **Table 3** presents the summary of the chemical composition of all these tesserae, including the main group and the outliers.

Discussion

The glass tesserae excavated from the Petra Church were classified into 32 colours. The different colours of these tesserae were remelted from different chemical compositions, especially the components that are related to the colourants or opacifiers. All the tesserae are of opaque colours. The only exception is the transparent support gold tessera which was a common type in the Byzantine period.[59] The majority of the tesserae from the Petra Church are of a similar base glass. The exceptions are three colours of tesserae: red, black and transparent support gold. The black and red tesserae are close to the majority of the tesserae from the Petra Church in terms of their base glass except for some additions which are related to the ingredients which were added to give them their colour. The transparent support gold tessera is of a different base glass, with higher contents of soda, iron oxide and manganese oxide, as well as lower contents of lime and alumina. This indicates that the glass of these tesserae was either made from different raw materials or during different periods than the Levantine groups. This glass composition is similar to other glass sample compositions analyzed from different Roman sites and dated between the 1st and 4th centuries.[60] The presence of compositional outliers in tesserae assemblages has been recorded previously in other sites. For example, the transparent gold sheet tesserae in the collection from San Marco were compositionally distinct from the other tesserae found. The presence of red and black tesserae with a different composition than the rest of the tesserae in the same assemblage has been previously recorded at several other Byzantine sites.[61] At Shikmona, opaque red tesserae differed in their base glass composition from the other colours found at the same site. It seems that these are technically demanding glasses, which were probably produced by other workshops specializing in these colours, and may therefore have been more expensive. It therefore appears that in order to use different ranges of colours it may have been necessary to obtain glass from more than one source.[62]

All the tesserae samples of the Petra Church contain manganese oxide and phosphorus oxide. The exception is the transparent support gold tessera, which has a very low phosphorus oxide content below the detection limit of the microprobe. Also, an ochre brown sample had a very low manganese oxide below the detection limit. However, calcium phosphate and manganese oxide were not the only additives in the tesserae base glass. Obviously, different colourants were used to colour other tesserae as mentioned earlier.

It is interesting here to refer to the old and new definitions of the tesserae colours that were given by Fiori where the new definition is more relevant to the discussion of the additives responsible for the tesserae colours (**Table 2**):[63]

1. Tesserae samples 1 to 7 were defined as green to yellow; these samples have relatively high contents of lead, tin and copper oxides, with some traces of zinc oxide. These samples all contain lead tin oxide-rich particles as noted above.
2. Tessera sample 8 (red) has relatively high contents of potash, lead, copper, zinc and tin oxides. The red tesserae may have been imported from a different workshop that specialized in specific colours. Most likely, the natron-based glass of this colour was mixed with plant ash for colouring.
3. Tesserae samples 9 to 15 and sample 32 were re-defined as the grey series. These samples have the highest content of calcium phosphate as well as high contents of manganese oxide.
4. In addition to this series, sample 29 (ochre brown) has a relatively high content of phosphorus oxide but it differs from the grey series samples by having a very low manganese oxide content. The ochre brown tessera has a similar base glass as the majority of the tesserae, but it is strange that sample 29 has manganese oxide below the detection limits. The lack of manganese oxide in this

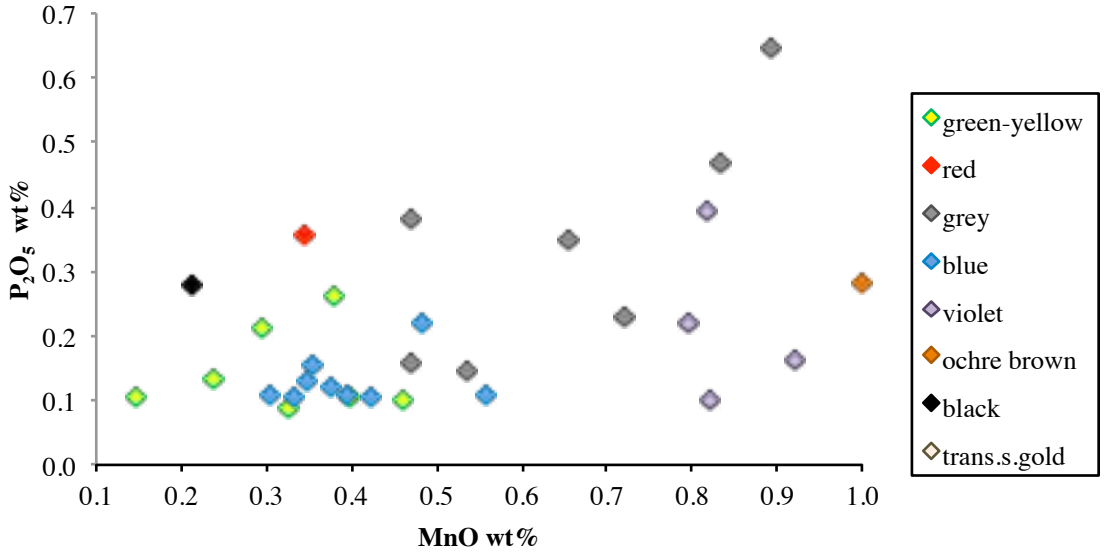


Figure 3 Scatter diagram presenting the relationship between manganese oxide and phosphate contents between the different colour series of the Petra Church tesserae

sample could be due to technological reasons necessary to obtain the required colour.

5. Tesserae samples 16 to 24 were re-defined as the turquoise to blue green series. These samples have relatively high contents of copper oxide and trace amounts of lead, zinc and tin oxides. The samples of dark blue colour also contain cobalt.
6. Tesserae samples 25 to 28 were defined as the violet (purple) series, which has the highest contents of manganese oxide and relatively high contents of phosphorus oxide.
7. Tessera sample 30 (black) has the highest content of iron oxide.
8. Tessera sample 31 (transparent support gold) has the highest content of manganese oxide. Iron oxide is present with a high content in this sample as well. This concentration indicates that the glassmaker wanted to make these tesserae as clear as possible in order to let the gold sheet act as a reflector. Adding manganese oxide deliberately as a decolourant is common to all Byzantine tesserae of transparent glass with sheet metal, independent of geographic provenance.[64] The transparent support gold tesserae were either imported from a different workshop or made from glasses of Roman origin.

Figure 3 presents these different colour series among the Petra Church tesserae and the relationship between their manganese oxide and phosphorus oxide levels. It is clear from the diagram that the phosphorus and manganese oxides are higher in the grey and violet (purple) tesserae. Both manganese oxide and calcium phosphate (bone ash) particles increased the level of phosphorus and manganese oxides in the surrounding glass matrix. Here it is worth mentioning that the purple and grey series tesserae are unique in containing bone ash and manganese oxide particles for their colours. These two particles have not been previously recorded in any glass matrix excavated from other sites dating from the 6th century. Therefore, until similar inclusions are found, these glasses might be considered characteristic of the Petra region, but further research is necessary.

The tesserae differ from the transparent glass excavated in the Petra Church because of their opaque coloured composition. It is most likely that the opaque tesserae and the transparent glass were made from the same base glass.[65] The raw glass for tesserae would then be taken to another workshop where the colourants and opacifiers or even decolourants were manufactured and added to the base glass according to the required colour: this is generally believed to be a completely separate process from primary glassmaking.[66] Therefore, the raw glass for the tesserae required further melting while adding the additives which decreased the amount of soda. Since the soda is volatilized during the melting process, the more glass is remelted the more soda volatilizes and is lost. As a result, the soda contents in the tesserae became lower than that of the primary base raw glass (**Fig. 4**). This does not necessarily indicate a different base glass, but rather a difference in the technological process involved in the making of these glass tesserae.

One might expect that the cakes were used for cutting tesserae. This could be based on similarities in their colours plus microscopic observations, especially in the grey and violet tesserae. The tesserae of these colour series and the cakes are similar in consisting of almost analogous amounts of gas bubbles and particles. Nevertheless, the average of soda contents in the cakes (13.7wt%) is less than the average soda contents in the tesserae (14.7wt%). This indicated that the cakes were melted for a longer time than the tesserae and, therefore, the tesserae cannot have been cut from the cakes. **Figure 4** shows that the soda level in the core cake group of samples from the Petra Church is present in lower levels than in the transparent core group and the tesserae samples. Again, this does not necessarily indicate that the cakes are from a different glass origin than the samples of these groups. Instead, the level of soda contents in the glass cakes reflects a different technological process for making these fragments. Glass cakes are heterogeneous glassy materials with several undissolved inclusions in comparison

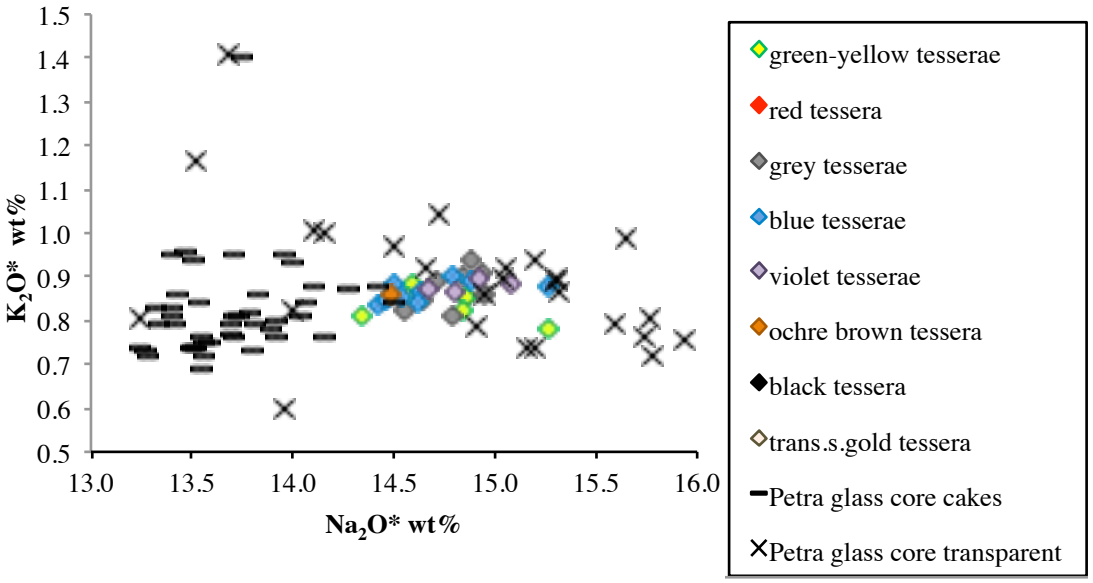
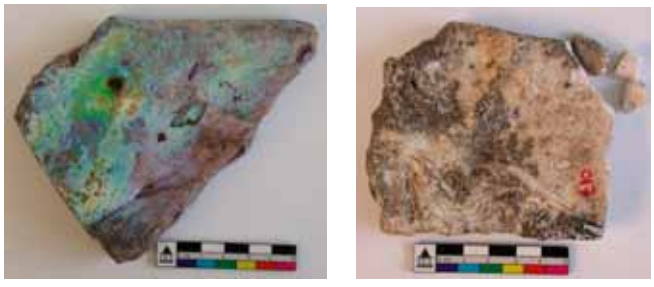


Figure 4 Scatter diagram showing the relationship between soda and potash contents (the reduced values) in the tesserae, transparent glass and glass cakes of the Petra Church

to the transparent glass and tesserae samples. Therefore, it is clear that the glass of these fragments was re-melted more than once, perhaps for adding inclusions or recycling other glasses. As a result, with the constant melting and re-melting, soda is lost and this is observed as a decrease in levels present in the base glass, if not for the heterogeneity of the glass cake composition.

The glass cakes are similar to the majority of the mosaic tesserae in terms of their appearances (**Pl. 5a–b**); both categories are considered to be opaque coloured glasses. The main difference between glass cakes and tesserae is that the latter have straight cut-faces, while the cakes are of irregular shape. As noted above, microscopic examination of the glass cakes and tesserae shows similarities in their structure as well. Stereomicroscopy examinations show that the majority of the gas bubbles in the structures of the cakes and tesserae exist in the same areas where the inclusions are concentrated. The presence of both calcium phosphate and manganese oxide particles is the significant characteristic for both glass cakes and tesserae excavated from the Petra Church. These two particles were found to occur together within the same fragment side by side in both tesserae and cake samples.[67] These particles were detected in the heterogeneous glass cakes and in the grey and violet tessera samples –as mentioned above – which were analyzed by SEM-EDX. The common feature in the samples that contain these particles is their opacity.

Plate 5a–b Glass cakes from the Petra Church



Calcium phosphate is known to have been used as an opacifier in later periods. Manganese oxide would not have been added as an opacifier as this component is well known for being added to the glass matrix either to act as a decolourizer or to achieve a purple colour, depending on quantity present and melting conditions. It is possible that these manganese oxide particles are the mineral pyrolusite (MnO_2). Laboratory experiments have shown that adding pyrolusite directly to a glass melt will not result in a uniform distribution.[68] This may explain why the manganese oxide particles in the Petra Church cakes and tesserae have not dissolved. Manganese oxide particles appear to have been used in the white/grey tesserae and cakes as a decolourizer and in the purple tesserae and cakes for the purple colour. However, this does not explain why these particles were found in most heterogeneous cake fragments of different colours and side by side in the same sample. This is still a puzzle that needs further research and investigation. Of course, many other explanations for the variability noted with these particles in the glass can be suggested. For now these ideas remain novel and more analyses could further clarify the picture.

Yet this emphasizes the fact that there was a considerable demand for glass, especially for tesserae, in Byzantine churches.[69] The economic conditions prevailing at Petra in the Byzantine period are not as clear as when Petra was a major emporium for international trade during Nabataean times. The excavation of the church and other Byzantine sites in Petra proved that it was still functioning throughout the 6th century. According to the scroll archives, landownership and agriculture were the backbone of Petra's society, but there are no records of any long-distance trade.[70] One might speculate that to use a range of different chemical compositions of coloured glass tesserae such as those found in the Petra Church mosaics, that it was necessary to obtain glass from more than one source. This is made even more likely given that the colours of some tesserae, e.g. black and red ones, were made in workshops which specialized in different colours.[71]

Consequently, these glass finds, especially the coloured tesserae in the church, have raised many questions. How did the tesserae get to Petra? Were the glass mosaic tesserae made locally, on site, or imported? And if imported, where were they imported from? Bringing such quantities of glass tesserae overland to Petra would not have been an easy feat. The acquisition of coloured glass, such as cakes, glass sheets and tesserae, needs to be considered as a new aspect of the economy of Petra. Interregional trade routes may not be recorded during Petra's Byzantine period, but it does not mean they did not exist. On one hand, the different glass compositions may prove that there was trading activity to/from Petra to obtain these glasses and, on the other hand, the new discovery of Byzantine glasses with bone ash and manganese oxide particles, which had not been recorded previously, raises the question of the sources of these glasses, and if they were local or imported.

Therefore, one should consider that the sources of these glasses are most likely a reflection of Petra's regional economic connections, even though there is no mention of trading activities in the scroll archive. There might have been local workshops for glass production which are unexcavated until now. However, the fact that there were glass fragments with different compositions indicates that even if there was a local production for one group, there are other groups that may have been imported from different sources. It is believed that mosaic decoration on a large scale involved huge financial investment and industrial organization.[72] On this basis, the wall and floor mosaics of the Petra Church required thousands of tesserae to furnish the church.

Conclusion

This paper presents a necessary source of typological and chemical analyses of an assemblage of the coloured tesserae excavated from the Petra Church. This data contributes to our general knowledge of Late Roman-Byzantine-Early Islamic glasses in the Levant. The chemical compositions of these tesserae display a variety of colours and different hues which inform us not only about the skill of the glassmakers who produced them, but also about the existence of trade routes to and from Petra. As a result this reflects the economic activities that took place in Petra during the Byzantine period. Overall, they shed new light on the economy of Byzantine Petra, whilst, at the same time, they present new opportunities for research into the consumption of Levantine glass in south Jordan.

Acknowledgements

I would like to thank the following for their support and co-operation during my research on which this paper is based. My particular thanks are due to my supervisors Thilo Rehren and Clifford Price for their supervision of my research. Ian Freestone with his constructive comments was also a continuous support during this research. Thanks to Pierre and Patricia Bikai for their generosity in facilitating the selection of the glass samples from the Petra Church Project. For all these samples, permission to export them from Amman to London would not have been granted without the efforts of staff in the Department of Antiquities in Jordan, whom I gratefully acknowledge. My sincere thanks go to the staff of the Wolfson Archaeological Science Laboratory at the Institute of Archaeology (UCL), particularly to Kevin Reeves, Philip Connolly, Sandra Bond and Simon Groom for their kind help and advice during sample preparation and operating the EPMA and SEM analysis and microscopic examinations. I appreciated the contribution of Elisavet Markou during her MSc research dissertation that included analyzing half of the glass tesserae samples from the Petra Church. I gratefully acknowledge financial support from the following: The Barakat Trust, Joukowsky Family Foundation, Overseas Research Students Award/United Kingdom Scholarships for Research International Students, Marie Curie Host Fellowship for Early Stage Researchers Training award under contract MEST-CT-2004-514509. I am also grateful to the Leverhulme Trust for sponsoring the international network for the composition of Byzantine glass mosaic tesserae, and in particular to Liz James, Bente Bjørnholt and Chris Entwistle for facilitating my participation in their different workshops, especially this conference, 'New Light on Old Glass: Byzantine Glass and Mosaics'.

Notes

1 P. Watson, 'The Byzantine period', in B. MacDonald, R. Adams and P. Bienkowski (eds), *The Archaeology of Jordan*, Sheffield, 2001, 461–502, esp. 461.
2 Z. Fiema, 'Cultural history of the Byzantine ecclesiastical complex at Petra', *American Center of Oriental Research Newsletter* (hereafter *ACORN*) 7/2 (1995), 1–3, esp. 1; K. Russell, 'The Petra project', *ACORN* 4/1 (1992), 1–2, esp. 1.
3 J. Frösén and Z. Fiema, 'The Petra papyri', *ACORN* 6/2 (1994), 1–3, esp. 2–3; L. Koenen, 'The carbonized archive from Petra', *Journal of Roman Archaeology* 9 (1996), 177–88; R. Schick, Z. Fiema and K. 'Amr, 'The Petra Church project 1992–93. A preliminary report', *ACORN* 3/7 (1993), 55–66, esp. 56.
4 T. Gagos, 'Update on the Scrolls', *ACORN* 9/1 (1997), 11–12, esp. 12.
5 J. Taylor, *Petra*, Amman, 2005, 100.
6 Z. Fiema, 'Late-Antique Petra and its hinterland: recent research and new interpretations', in J. Humphrey (ed.), *The Roman and Byzantine Near East, vol. 3, Journal of Roman Archaeology Supplementary Series* 49 (2002), 191–252, esp. 200; Z. Fiema, R. Schick and K. 'Amr, 'The Petra Church project: interim report, 1992–94', in J. Humphrey (ed.), *The Roman and Byzantine Near East, Journal of Roman Archaeology Supplementary Series* 14 (1995), 287–303, esp. 293.
7 Fiema *et al.* (n. 6), 293–5.
8 Schick *et al.* (n. 3), 56.
9 Z. Fiema, 'Reconstructing the history of the Petra Church: data and phasing', in P. Bikai (ed.), *The Petra Church*, Amman, 2001, 6–137, esp. 66; Fiema *et al.* (n. 6), 293.
10 Z. Fiema, 'Historical conclusions', in Bikai (n. 9), 425–38, esp. 437.
11 Fiema (n. 9), 10–119.
12 Ibid.
13 Ibid., 97.
14 Ibid., 97.
15 Ibid.
16 Ibid., 97.
17 Ibid., 97–8.
18 Ibid.
19 Ibid., 53; T. Waliszewski, 'The wall mosaics', in Bikai (n. 9), 300–2, esp. 300.
20 Waliszewski (n. 19), 301.
21 Fiema (n. 9), 97–8.
22 D. Harden, 'Ancient glass III: post-Roman', *The Archaeological Journal* 128 (1971), 78–117, esp. 83.
23 E. Swift, 'Byzantine gold mosaic', *American Journal of Archaeology* 38 (1934), 81–2, esp. 81; Waliszewski (n. 19), 301.
24 P. Bikai, 'The churches of Byzantine Petra', *Near Eastern Archaeology*

65 (2002), 271–6, esp. 275; M. Perry and P. Bikai, 'Petra's churches', in Th. Levy, M. Daviau, R. Younker and M. Shaer (eds), *Crossing Jordan: North American Contributions to the Archaeology of Jordan*, London, 2007, 435–43, esp. 438.

25 I. Freestone, 'Looking into glass', in S. Bowman (ed.), *Science and the Past*, London, 1991, 37–56, esp. 48.

26 C. Fiori, 'The composition of glass wall mosaic tesserae', in Bikai (n. 9), 303–5, esp. 303; Waliszewski (n. 19), 301.

27 J. Henderson, 'Some chemical and physical characteristics of ancient glass and the potential of scientific investigations', *The Glass Circle* 7 (1991), 67–77, esp. 69.

28 R. Brill, *Chemical Analysis of Early Glasses, vol. 2: The Tables*, Corning, New York, 1999, 544; S. Frank, *Glass and Archaeology*, London, 1982, 47.

29 E. Markou, 'Glass colorants in Byzantine tesserae from the Petra Church, Jordan', unpublished MSc dissertation, Institute of Archaeology, University College London, 2005.

30 Fiori (n. 26).

31 Ibid.

32 F. Marii and T. Rehren, 'Archaeological coloured glass cakes and tesserae from the Petra Church', *Annales du 17e Congrès de l'Association Internationale pour l'Histoire du Verre*, Antwerp, 2009, 295–300, esp. 297.

33 Markou (n. 29), 47.

34 Fiori (n. 26).

35 Markou (n. 29), 49.

36 F. Marii, 'Glass, glass cakes and tesserae from the Petra Church in Petra, Jordan', unpublished PhD thesis, Institute of Archaeology, University College London, 2008, Appendix 5.

37 Marii and Rehren (n. 32), 297.

38 Markou (n. 29).

39 Marii (n. 36), Appendix 5.

40 I. Freestone, M. Bimson and D. Buckton, 'Compositional categories of Byzantine glass tesserae', in *Annales du 11e Congrès de l'Association Internationale pour l'Histoire du Verre, Bâle / 29 août – 3 septembre 1988*, Amsterdam, 1990, 271–9; M. Heck, Th. Rehren and P. Hoffmann, 'The production of lead-tin yellow at Merovingian Schleitheim (Switzerland)', *Archaeometry* 45 (2003), 33–44; S. Poole, 'Yellow mosaic tesserae: their manufacture and use in Byzantine Israel', Unpublished MSc dissertation, Institute of Archaeology, University College London, 2000; T. Wypyski and L. Becker, 'Glassmaking technology at Antioch: evidence from the Atrium House triclinium and later mosaics', in L. Becker and C. Kondoleon (eds), *The Art of Antioch*, Worcester, 2005, 115–75, esp. 124.

41 Markou (n. 29), 56.

42 Brill (n. 28), 9.

43 E. Sayre and R. Smith, 'Compositional categories of ancient glass', *Science* 133 (1961), 1824–6.

44 D. Foy, M. Vichy and M. Picon, 'Lingots de verre en Méditerranée occidentale (IIIe siècle av. J.C. – VIIe siècle ap. J.C.)', in *Annales du 14e Congrès de l'Association Internationale pour l'Histoire du Verre, Italia Venezia – Milano 1998*, Lochem, 2000, 51–7.

45 I. Freestone, Y. Gorin-Rosen and M. Hughes, 'Primary glass from Israel and the production of glass in Late Antiquity and the Early Islamic period', in M.-D. Nenna (ed.), *La route du verre. Ateliers primaires et secondaires du millénaire av. J.C. au Moyen Äge*, Lyon, 2000, 65–83.

46 Freestone *et al.* (n. 40).

47 A. Shugar, 'Byzantine opaque red glass tesserae from Beit Shean, Israel', *Archaeometry* 42 (2000), 375–84.

48 I. Freestone, C. Stapleton and V. Rigby, 'The production of red glass and enamel in the Late Iron Age, Roman and Byzantine periods', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003, 142–54.

49 W. Turner, 'Studies of ancient glasses and glassmaking processes. Part IV. The chemical composition of ancient glasses', *Journal of the Society of Glass Technology* 40 (1956), 162T–186T, esp. 178T.

50 Wypyski and Becker (n. 40).

51 Fiori (n. 26), 303.

52 Freestone *et al.* (n. 40).

53 Wypyski and Becker (n. 40), 129.

54 Freestone *et al.* (n. 40).

55 R. Brill and N. Cahill, 'A red opaque glass from Sardis and some thoughts on red opaques in general', *Journal of Glass Studies* 30 (1988), 16–27.

56 Shugar (n. 47), 379.

57 Freestone (n. 25).

58 Poole (n. 40).

59 Freestone *et al.* (n. 40); Swift (n. 23).

60 Marii (n. 36), 142.

61 Freestone (n. 25); Freestone *et al.* (n. 40); Wypyski and Becker (n. 40).

62 Freestone (n. 25), 48.

63 Fiori (n. 26).

64 M. Vandini, C. Fiori and R. Cametti, 'Classification and technology of Byzantine mosaic glass', *Annali di chimica* 96 (2006), 587–99.

65 F. Marii and Th. Rehren, 'Levantine glass of Petra characteristics', in *Annales du 18e Congrès de l'Association Internationale pour l'Histoire du Verre, Thessaloniki 2009*, ZITI, Thessaloniki , 2012, 277–83, esp. 279.

66 R. Brill, 'Scientific investigations of the Jalame glass and related finds', in G. Weinberg (ed.), *Excavations at Jalame: Site of a Glass Factory in Late Roman Palestine*, Columbia, 1988, 257–94; I. Freestone, M. Ponting and M. Hughes, 'The origins of Byzantine glass from Maroni Petrera Cyprus', *Archaeometry* 44 (2002), 257–72.

67 F. Marii and Th. Rehren, 'Opaque glass cakes from the Petra Church and their interpretation', *Proceedings of the 36th International Symposium on Archaeometry, 2nd–6th May Quebec, Université Laval, 2006*, Quebec, 2009, 339–47, esp. 343.

68 Brill (n. 66), 276.

69 L. James, 'Byzantine glass mosaic tesserae: some material considerations', *Byzantine and Modern Greek Studies* 30 (2006), 29–47.

70 J. Frösén, 'Archaeological information from the Petra papyri', *Studies in the History and Archaeology of Jordan* VIII (2004), 141–4, esp. 144.

71 Freestone (n. 25), 48; James (n. 69), 42.

72 James (n. 69).

Chapter 3
Studies in Middle Byzantine Glass Mosaics from Amorium[1]

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Introduction

The following paper is an updated summary of studies conducted during the excavation seasons of the Amorium Project in 2000 and 2001. Most of it was published in volume 2 of the Amorium Reports in 2003; shortly afterwards Mark Wypyski published the results of his analysis of tesserae from Amorium.[2] A review was therefore necessary and further details have also been included in this text.

Amorium lies at the western edge of the central Anatolian plateau about 250km southwest of Ankara, Turkey. In the Byzantine era it was the administrative seat of the *thema* Anatolikon and contemporary Byzantine and Arab sources describe it as an important and prosperous city. As is well known, its Early Medieval phase ended in AD 838 as a result of the siege and destructive conquest by the Arab army led by al-Mutasim. As far as we can understand from the stratigraphy of the excavated areas, it took at least a generation before the city developed again into a large and prosperous settlement. Its history seems to taper off in the 11th century: the latest coins found so far are of Alexios I (r. 1081–1118) and are dated between 1092 and 1118.[3] Traces of further churches have been found in and around the city, but have not been excavated yet.[4]

The Lower City Church

The remains of the Lower City Church are situated in the southwest of the city and are still under excavation. This was begun in 1989 by Martin Harrison when his team uncovered the upper parts of the nave and aisles. The lower areas down to the beautiful *opus sectile* floor in the nave and the brick or stone tiled floors of the aisles were excavated between 1996 and 1998. Fresco and mosaic fragments were found during all phases of excavation work; however, not all contexts yielded the same amount of fragments.[5] In recent years work has focused on adjoining areas, such as the narthex, the atrium, a baptistery on the north side and most recently a side chapel on the south. A large number of graves have also been excavated in the narthex, atrium and all around the church.[6]

Several building phases have been established by the excavation. Of the Early Christian basilica, which was destroyed in the siege of AD 838, only the lower courses of the walls and stylobate remained standing. That the destruction included a severe fire can be seen from the way that the limestone blocks splintered and by the blackened lower parts of the walls. Piers and pilasters as support for vaults and a dome were added into this shell during the Middle Byzantine era, probably at the beginning of the 10th century. During the next centuries the church experienced several modifications, but these were of a localized nature.

After the abandonment of the city following 1170, the building was reused as a farmhouse in the Seljuk era. The walls were heavily scraped to rid them of frescoes and partially whitewashed. A wall built in the west end of the south aisle sealed off part of a fresco, one of the two cases where a fresco remains *in situ*. The other was found in the entry room to the southeastern chapel and is in a very fragmented state. The fragments on the east wall belong to an image of the Virgin Hodegetria and the drawing shown in **Plate 1** superimposes a sketch of the 10th-century ivory in

Plate 1 Fresco fragments of the Virgin Hodegetria on the east wall of the anteroom to the southeastern chapel, Lower City Church, with reconstruction of a sketch of a 10th-century ivory in the Metropolitan Museum of Art, New York

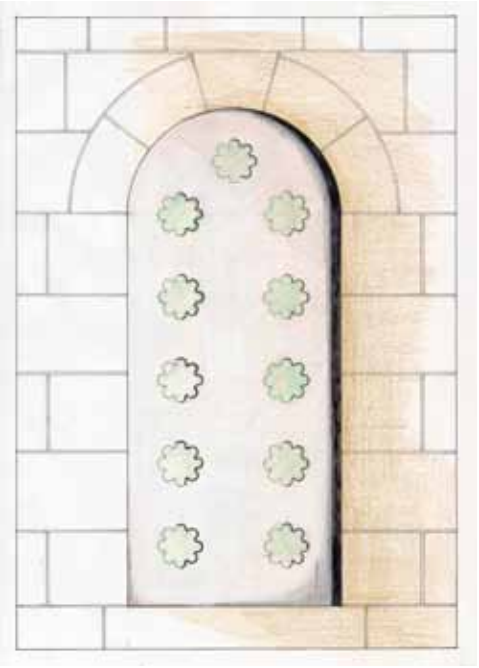


Plate 2 Reconstruction of plaster window screen, Lower City Church

the Metropolitan Museum, New York, for a better understanding of what remains on the walls.

Some of the graves in and around the church complex contained the goods of wealthy occupants, for example, glass bracelets.[7] The glass objects from Amorium were published by Margaret Gill in the first volume of the Amorium Reports,[8] and work is continuing on the more recent glass finds.

Examples for other uses of glass in the church are a few fragments of architectural inlay. Gill recorded leaf-shaped inlays, made from glass slabs, as well as a triangular one clipped from a glass vessel sherd.[9] Another piece might have once had a gold sheet underneath the still existing lamina/cover glass. Their purpose is not clear: similar inlays from green glass, gold glass and amethyst are for example known from Saraçhane in Istanbul.[10] Also among the glass finds from the church are window fragments. Their glass panes are circular and had been set into beautifully ornamented plaster screens (**Pl. 2**).[11] A very recent article published by scholars not connected to the excavation has mentioned rectangular window panes and reconstructed the windows as having wooden transennae, but for this there is no material evidence.[12]

The excavation of the church has yielded many fresco fragments spread throughout the entire building. It appears

Plate 3 Fresco fragment from the southeast chapel, Lower City Church, showing parts of a face

that fresco was the main decoration of the church, and the mosaics restricted to certain places. The frescoes can give us some aid in dating the decoration of the church. The use of ultramarine, that is ground lapis lazuli, is very similar to that used in the second Tokalı Kilise church in Cappadocia, dated to the 10th century.[13] Fragments found in the southern chapel in 2007 and 2008 (**Pl. 3**) show a painting style related to that of the so-called 10th century *Menologion* of Basil II (Vat. Graec.1613). Similarities can be seen in the circular red cheeks, the dark shadows under the eyes and the tops of the candles (for example *Menologion* fol.142). This stylistic relationship can also be seen in the way garments were painted: the fresco *in situ* on the southern wall of the church for example shows garment folds above the knee of the figure which are very closely related to those of figures in the *Menologion*.[14] The fresco belongs to a third layer – in general, the church seems to have been redecorated, at least partially, several times, although the technique and style are related.[15] Two head fragments, again from the southeastern chapel, illustrate the painting style further: the head of a king, perhaps David or Solomon, wears a crown with a shape similar to that of the emperor in the mosaics of Hagia Sophia in Istanbul,[16] and this detail might also support a date of the frescoes to a time in the 10th century.

Just as the fresco fragments are mostly very small, so are the mosaics. Most of what was found are loose tesserae and some setting bed fragments. The make-up of the setting bed plaster is the same as that of the frescoes and one fresco fragment actually has a tessera embedded in the plaster. It is therefore likely that both the mosaics and fresco were applied at the same time, the artists working from the vaults and ceilings down towards the floor.

Besides the wall mosaics there are the remains of a ring-shaped mosaic field set into the elaborate *opus sectile* floor of the western nave (**Pls 4–5**).[17] From the setting traces in the floor mortar it is clear that this mosaic served as the frame for a stone disc, which can be considered to be an *omphalion* or *rota*. The mosaic ring itself was framed by radially cut stone

Plate 4 Mosaic insert in *opus sectile* floor of western nave, Lower City Church, directly after excavation

Plate 5 Partial view of mosaic insert, Lower City Church, after 2001 conservation work

slabs filling a square field, situated roughly halfway between the western steps of the ambo and the threshold of the main entrance from the narthex.[18] The tesserae are made of stone and glass in several hues, and are set into a much harder setting bed plaster containing brick and marble splinters. The dimensions of some tesserae are slightly larger than those of the wall mosaics (see appendix below), but in general it seems that this border was set with a selection of the same glass material as the wall mosaics and are likely to be from the same time period. The sharp edges of the setting bed and the position of tesserae almost on its outer edge suggest that the mosaic was set after the *opus sectile* tiles had been laid (for conservation purposes the mosaic was enclosed by a wide band of modern plaster which unfortunately distorts its relation to the surrounding marble tiles).[19] The central disc of these tiles has been removed as well as most of the others. Only the southeastern corner of the square panel remains, to show that the ring of radial tiles around the mosaic and the spandrels of the surrounding square consisted of creamy white marble, while the strips to the north and south were made up of greyish-white marble panels (the hundreds of *opus sectile* tiles recovered from the church have not been studied yet). Henry Maguire mistakenly places the mosaic at the centre of the *omphalion*,[20] while it actually serves as a frame for a marble disc.[21] The mosaic shows a twisted ribbon pattern (guilloche), the ribbons enclosing circles which are filled with stars made of lines. The repetition of the pattern is not very accurate, and it appears that the concept of twisting ribbons was not totally understood by the mosaicist, or more likely by someone who made repairs to the western half of the fragment at a later date.

Table 1 Glass tesserae colours according to Kornerup/Wanscher (KW)

Hue	KW Number	KW description
Red	9C8	Lacquer red / Lake red
Red	9D8	Garnet brown
Red	9E8	Cuba / Oxblood red
Red	8F8	Red brown
Dark turquoise	23F8	Dark turquoise
Dark turquoise	24E7	
Light turquoise	24B5	Light grey turquoise
Dark emerald green	26E6	
Light emerald green	26C6	
Medium yellow green	27D8	Peacock green, deep green
Light yellow green	28C8	'Blankettgrün'
Light yellow green	28D8	
Light yellow green	29C8	Apple green
Light yellow green	29C7	
Brown	5F4	Sepia brown, 'biberbraun'
Brown		Teak brown
Dark blue		Lapis blue

The tesserae: size and colour

Faced with such a collection of setting bed fragments and bags of tesserae one has few options but to focus on details, which means sorting them by colours and counting them. However, the fragmentary state of the mosaics also has advantages since many single tesserae and the setting bed fragments could be studied from all sides. It was not a problem to take samples for analysis as it did not require invasive procedures.

Altogether there are more than 500 bags of tesserae; sometimes, however, they contain only one or two useable examples. The total number of tesserae is just over 20,000. By counting the number of tesserae used on areas of 5 x 5cm, a calculation was made for the amount necessary to decorate the bema and the apse of the Lower City Church (**Tables 2–4**). Samples of each tessera colour were also weighed and their dimensions noted, and the average for an 'ideal' tessera size was found to be 6 x 8 x 8mm: these are very common dimensions in all colours, although smaller and larger are also well represented. The total amount of tesserae needed was therefore around 2 tons. The numbers in **Table 4** are based on the assumption that only the apse conch and walls and the vault over the bema were adorned with mosaics, and not the central dome.[22] This is not a very large number compared to those given by Liz James in her study of mosaic materials.[23]

The surviving number of tesserae is 1% of the amount that would have been needed. This is of course disappointing, but it is reflected and supported by the fact that it has been almost impossible to reconstruct any larger areas from the fresco fragments. Again, too much was lost, and in many instances there are tantalising similarities

Table 2 Weights and dimensions of tesserae samples from the Lower City Church at Amorium

Colour	weight g	length mm	width mm	height mm	weight of 10 in g	cubic mm	weight ratio	average weight	'ideal' tessera weight
Red	1.42	8	8	9		576	0.002465		
	0.48	6	6	6		216	0.002222		
	1.26	10	7	7		490	0.002571		
	0.78	6	6	8		288	0.002708		
					10.05			0.002492	0.956857
Brown	0.57	9	5	5		225	0.002533		
	0.92	8	8	6		384	0.002396		
	1	8	7	6		336	0.002976		
	0.68	8	7	5		280	0.002429		
					7.7			0.002583	0.992057
Dark turquoise	0.4	6	5	6		180	0.002222		
	0.88	6	7	7		294	0.002993		
	0.73	8	8	6		384	0.001901		
	0.92	7	7	8		392	0.002347		
					7.09			0.002366	0.908486
Dark emerald	1.05	7	8	8		448	0.002344		
	0.84	6	7	10		420	0.002000		
	0.67	8	7	5		280	0.002393		
	0.76	8	7	6		336	0.002262		
	1.11	8	8	6		384	0.002891		
	0.98	8	8	5		320	0.003063		
					8.13			0.002492	0.956905
Ultramarine	0.51	7	7	5		245	0.002082		
	0.48	6	5	7		210	0.002286		
	0.52	7	6	6		252	0.002063		
	0.76	8	8	6		384	0.001979		
					3.28			0.002103	0.807361
Olive green flint	0.64	7	6	6		252	0.002540	0.002540	0.975238
	0.81	8	8	4		256	0.003164		
	0.61	9	6	7		378	0.001614		
	0.6	8	8	6		384	0.001563		
	0.22	6	4	5		120	0.001833		
					6.10			0.002043	0.784671
Light turquoise	0.5	8	7	4		224	0.002232		
	0.4	5	7	6		210	0.001905		
	0.49	7	5	6		210	0.002333		
					4.35			0.002157	0.828190
Light emerald	0.74	9	5	7		315	0.002349		
	0.67	7	7	8		392	0.001709		
	0.72	6	6	8		288	0.002500		
	0.42	5	5	6		150	0.002800		
					5.67			0.002340	0.898405
Black / violet	0.67	7	8	6		336	0.001994		
	0.67	7	6	8		336	0.001994		
								0.001994	0.765714
New gold	0.42	7	4	5		140	0.003000		
	1.1	8	8	6		384	0.002865		
	0.98	8	9	5		360	0.002722		
	0.71	5	7	6		210	0.003381		
	0.82	7	6	8		336	0.002440		
					6.93			0.002882	1.106552
Silver	0.66	6	6	6		216	0.003056		
	0.57	7	7	6		294	0.001939		
					4.93	mostly without cartellina		0.002497	0.958912
Old gold	0.67	5	6	8		240	0.002792		
	0.96	7	6	7		294	0.003265		
	0.47	5	5	7		175	0.002686		
	0.82	7	5	8		280	0.002929		
					6.86			0.002918	1.120441
Yellow green	0.73	6	6	8		288	0.002535		
	0.76	7	7	7		343	0.002216		
	0.37	10	4	4		160	0.002313		
	0.61	6	6	6		216	0.002824		
					5.29			0.002472	0.949156

Table 3 Estimated/average weight of 10,000 tesserae

Colour	Weight of ideal tessera	Weight of 10,000 in kg
Red	0.95685714	9.57
Brown	0.99205714	9.92
Dark turquoise	0.90848639	9.08
Light turquoise	0.82819048	8.28
Dark emerald	0.95690476	9.57
Light emerald	0.89840544	8.98
Yellow green	0.94915581	9.49
Olive green	0.9752381	9.75
Ultramarine	0.80736054	8.07
Black/violet	0.76571429	7.66
New gold	1.10655238	11.07
Silver	0.95891156	9.59
Old gold	1.12044082	11.20
Flint	0.78467063	7.85
Average		9.29

between the fragments indicating that they belong together, but very often the joining piece is missing.

The results of the tesserae count are nevertheless interesting: for one, most (that is more than 80%), were found in area A3. This is the eastern end of the nave, the sanctuary with bema and apse. The second area with a somewhat higher number of tesserae is that just west of the sanctuary underneath the central dome of the church. All other areas, especially in the aisles, yielded very small amounts of tesserae, so it is likely that what was found there and under the dome had spilled over from the sanctuary. Glass was the most used material for tesserae: a small number were made of various kinds of stone, mostly flint, limestone and marble.[24]

Red is the most frequent colour found. Other significant clusters are the shades of blue and gold. A comparison of tesserae weights shows that the metallic tesserae are the heaviest. The numbers given here (**Table 2**) are the weight in kilograms for 10,000 of the 'ideal' tessera of each colour. To reach this number the length, width, height and weight of samples of each colour were recorded and then a volume-weight ratio was calculated that could in turn be applied to the 'ideal' tessera of 6 x 8 x 8mm mentioned above (**Table 3**).

The metallic tesserae belong to three groups: a small number of silver, a large number of gold with sharp-cut edges and a smaller number of gold tesserae that have softened edges forming a loaf-shape. Their glass is darker and more opaque. They seem to have been exposed to near-melting conditions, not hot enough to let the glass run but at least hot enough to soften it to assume the loaf shape (which is, when you imagine the tessera upside down on a vault, more or less the beginning of a drip). For these the weight shown in the table is a statistical value, because the melting process reduced their shapes slightly and the size of the 'ideal' tessera is never reached. It just means that they

Table 4 Amount and weight of tesserae necessary to cover ceiling surfaces in the Lower City Church

Apse wall 69 sq m + apse conch 46 sq m + bema vault 77 sq m = total 192 sq m
Average number of tesserae per 10 x 10cm: 118; per sq m 11800
x 192 = 2.265.600 tesserae needed for decoration of apse and bema
On average 10000 tesserae weigh 9.29kg
Total weight of tesserae needed: 2104,74kg = c. 2 tons

are far more dense than any of the other glass tesserae, as a result of the heating and melting.

Since some of these loaf-shaped gold tesserae have traces of mortar on their cover glass, they must have been used upside down to show their red undersides, which was a result of the base glass being poured onto a red substance. It also means that the tessera was already heat damaged before it was used in this setting. The conclusion in 2000 was that this showed a recycling of older material for the Middle Byzantine mosaics in Amorium.

In 2001 a small bag of tesserae was selected, with the permission of the Turkish authorities, to be taken to the Metropolitan Museum in New York for analysis. For this the tesserae had been sorted by surface colours, but Wypyski found that in some cases the core was different. The blacks, for example, are actually very dark, translucent violet glass. This had already been noticed during their study in Amorium, but the designation as black was kept since that is the appearance in the colour context of the mosaic. The light bluish grey tesserae had also been considered to be inferior material of bubbly and weathered glass since in many cases they have very irregular non-cubic shapes, and that perhaps they were also older and recycled. It turns out that air bubbles and calcium were deliberately added as opacifiers, and that there is no indication of their age in relation to the other glass tesserae. The surface colours of tesserae samples were also compared to the colour tables of Andreas Kornerup and Johan Henrik Wanscher,[25] which are also being used in Amorium to determine the colour of glazed pottery. The comparison was made in direct midday sunlight and the results are given in **Table 1**. In general it was found that such colour sampling is not very useful, since the glass colour varies within a single hue and possibly even within the cake or slab that the tesserae were cut from, and its sparkle detracts from the hue when compared with the rather more matte surface of the colour tables. The colour variation can be seen especially in the red hues, where many tesserae show streaks of darker red or brown.

Wypyski found that all the tesserae analyzed belong to the category of natron glass that was produced up until around AD 900. This corresponds well with the dating of the Lower City Church to the very late 9th or early 10th century from other factors. The gold tesserae belong to two sub-groups, and interestingly, each of these contain tesserae with sharply cut edges and loaf-shaped molten pieces. Thus the interpretation of old gold and new gold tesserae was not accurate, nor was the assumption that the mosaicists had, perhaps for lack of newly produced material, recycled an older mosaic for some of the tessera shades like the dark reds of the undersides of the loaf-shaped gold tesserae.

Glass and tesserae reuse

This is the point to consider the recycling and reuse of glass and glass tesserae in general. Written sources of the Middle Byzantine period give accounts of such activity in several instances, but it has not very often been set into an archaeological context. On the one hand, one should first distinguish between recycling tesserae as a base material for any kind of glass production and, on the other, the re-use of older tesserae in a new mosaic setting. Theophilus, for example, describes the former recycling practice for the production of enamels and there are several known cases where Roman tesserae were traded or imported for enamel making.[26]

Perhaps the large collection of small and very worn setting bed fragments found in a stash on the north side of the Lower City Church of Amorium represents the remains of a similar activity in later times: the glass tesserae were picked out of the fragments, to be recycled in a local glass product. Glass waste has also been found in the area of the Enclosure.[27]

Tesserae have been found as raw material for bead making or for glass production in general at other sites.[28] The recycling of glass objects other than tesserae, as well as waste and cullet, is discussed in detail in a 2006 study of glass from Sagalassos, Turkey;[29] a year later Veerle Lauwers published a bibliography of glass studies for Late Antiquity, including a short review of the question of recycling.[30]

The re-use of tesserae for mosaics is equally documented in the written sources. The best known case of such a practice is reported from the mosque of Córdoba; most recently Laurence Cunningham and John Reich noted about the decoration of its *mihrab*: 'To enhance the interior, Al-Hakam sent emissaries to the emperor in Constantinople with a request for workmen. Contemporary sources state that the emperor complied not only with workmen but also sent roughly seventeen tons of tesserae. The master mosaic artist, who enjoyed the hospitality of the caliph, decorated the interior of the mosque lavishly, finishing his work, according to an inscription, in 965.'[31] According to the historian al-Tabari the tesserae for Umayyad mosaics, for example those in the Great Mosque of Damascus, were collected from ruined cities.[32] Tabari also reports that the emperor sent '100 workmen, and sent 40 loads of mosaic cubes' to al-Walid for the decoration of the mosque at Medina.[33] In AD 684/5, the walls of the Ka'aba in Mecca were covered with marble and tesserae brought from the Ethiopian cathedral of Sana'a in Yemen.[34] In the Byzantine realm, Basil I is said to have removed the marble slabs and tesserae for the decoration of his Nea Ekklesia in Constantinople not only from Justinian's mausoleum at the Church of the Holy Apostles, but other sites as well.[35] Mosaicists and perhaps tesserae were sent to Kiev in the 11th century for the decoration of the church of St Sophia.[36] A miracle in the *Paterikon* of the Cave Monastery of Kiev mentions two Greek traders who had brought tesserae with them for sale, which were eventually used in the decoration of the monastery church.[37]

The material evidence for the re-use of tesserae in mosaics is scarce, since it is very hard to document as long as one is investigating an intact mosaic. Amorium is one of the few cases where this could be undertaken, and only because of the fragmented nature of the remains. One of the questions posed by James concerns the production of tesserae: whether they had been imported as finished products to the site of mosaic decoration specifically for a project or whether, as the archaeological evidence implies, the tessera glass was coloured and cut on site.[38] It is hard to imagine that the above-mentioned traders whose tesserae ended up in a mosaic at Kiev could have brought with them even a 'minor' amount like the two tons that would have been necessary in a building the size of the Lower City Church of Amorium. It is much more likely that such traders were taking smaller amounts of tesserae across northern Europe to be used in enamels or bead making, as has been mentioned above.[39] Since glass working does not require a very large industrial setting the mosaic glass/tessera production site of Amorium most likely has not been found yet or may never be found at all.[40] Fragments of glass cakes were found at Amorium, but their intended use remains unknown.[41]

Conclusion

In summary, even though the excavation of the Lower City Church has yielded tesserae and unrelated setting bed fragments, one can still extract meaningful information from them. Scientific analysis has shown that the Amorium glass tesserae belong to the natron glass group, and also that it shares characteristics with those of the Levant I and Egypt II sets, which were most common in the 4th to 7th and 8th to 9th century respectively.[42] The use of such glass in mosaics from the 10th century is not surprising in the light of written sources which report a widespread trade, import and reuse of tesserae during the Middle Byzantine era. As has been shown above, and also by Wypyski's study of the several groups of red glass in Amorium,[43] one can assume that the tesserae or the glass for their production was brought into Amorium from several different sources.

The distribution of tesserae within the church indicates that it was decorated with mosaics only above the sanctuary, whereas the remainder of the church was painted, although the paint colours included expensive lapis lazuli blue. This pigment is ground fairly coarsely and contains crystalline impurities which add a sparkle to surfaces painted with it. Large areas of lapis blue would have complemented the sparkle and glitter of the gold mosaics in the sanctuary and apse. From Elizabeth Hendrix's study of the painted enhancement of architectural elements we know that a very rare yellow pigment was used which had to be imported from the Far East.[44] The use of this yellow, lapis blue and gold glass is an indication of the wealth and ambitions of the church patrons.

In a very recent study, Irina Andreescu-Treadgold maintains the established concept that mosaics had an elite status, were very costly to produce and, therefore, a 'monumental decoration of unusual luxury'.[45] In the case of the Lower City Church of Amorium this seems to be true. However, the huge number of mosaic floors of varying quality in Early Byzantine churches all over the Mediterranean, and the use of mosaic floors in such profane installations as winepresses for example, show that mosaics

were more commonplace than we often think. That this can be applied to wall and vault mosaics as well is shown by James in her 2006 study in which she gives an overview of 'insignificant sites' with wall mosaics.[46]

A final question concerning the monetary value of the gold and silver used in the tesserae in Amorium must unfortunately remain unanswered, since the thickness of the metallic foil in these tesserae was not measured on site nor in the later analysis.[47]

Appendix: examples of mosaic fragments and tesserae from the floor mosaic (*omphalion* frame) in the Lower City Church, Amorium

1. Context AM93A2/60: tesserae of greenish to honey coloured transparent glass, red, light blue-light turquoise, light emerald, black, light yellow green, setting bed of hard mortar containing marble and brick splinters. Thickness of setting bed including tesserae *c.* 4cm, the tesserae have been set flush with the surface of the mortar. Fragment shows a leaf shape, whose outline is set of amber coloured tesserae, inner area set light turqoise, exterior light green. Tesserae dimensions: 3x4, 7x4, 4x5, 9x6, 9x5, 9x9mm.
2. Context A2/60: white marble tesserae besides red tesserae, splinters of amber glass tesserae (possibly with gold), bottle green. The gap between the tesserae in the setting bed is 2–6mm, tesserae have been set in rows, in some places however without any order.
3. Context A2/60: tesserae and setting bed fragment, colours: light green 7x8, 6x11, and 9x10mm, light emerald, light ('Egyptian') blue 9x9 and 8x9mm, bluish white, bottle green translucent, lapis blue 8x9 and 9x12mm. Tesserae set at distances of 2–6mm.
4. Context AM93 Church (unstratified find): to judge by the composition of the mortar the fragments come from the *omphalion* mosaic: glass tesserae in black, light turquoise, light green, light blue. 10x11, 7x8, 6x8mm. Tesserae set deep into the mortar so that a walking surface results.
5. Unrecorded context, setting bed fragments. The mortar contains a lot of crushed bricks and is therefore pinkish in appearance. Tesserae are light turquoise and black, set widely, on another piece they are light emerald and light yellow green. Mortar is up to 6cm thick and very compact.
6. 'Glass tesserae from mosaic floor' Context A2/60. Setting bed mortar is up to 5cm thick and contains crushed brick and very fine gravel. Tesserae: turquoise, light blue, lapis blue or black, set widely, surface is very even.
7. Context A2/54, contains white stone tesserae.

Notes

1 I am very grateful to Liz James and Chris Entwistle for inviting me to this symposium, and to the Leverhulme Trust and the British Museum for funding the conference. My work in Amorium began in 2000 and I would like to thank Christopher Lightfoot and Eric Ivison for the invitation to study the Amorium frescoes and their support. My thanks also go to Daniel Abuhatsira, who drew the walls of the southeast chapel and developed and drew the window reconstruction, and to Francesca Dell'Acqua for discussing the window plaster and pane fragments.

2 J. Witte-Orr, 'Fresco and mosaic fragments from the Lower City Church', in C.S. Lightfoot (ed.), *Amorium Reports II: Research Papers and Technical Studies* (BAR Int. Ser. 1170), Oxford, 2003, 139–58; M.T. Wypyski, 'Technical analysis of glass mosaic tesserae from Amorium', *Dumbarton Oaks Papers* 59 (2005), 183–92.

3 C.S. Lightfoot, 'Die byzantinische Stadt Amorium. Grabungsergebnisse der Jahre 1988 bis 2008', in F. Daim and J. Drauschke (eds), *Byzanz – Das Römerreich im Mittelalter. Teil 2,1: Schauplätze* (Monographien des RGZM 84, 2, 1), Mainz, 2010, 293–307, esp. 294ff, 300.

4 E.A. Ivison, 'Kirche und religiöses Leben im byzantinischen Amorium', in Daim and Drauschke (n. 3), 309–43, esp. 310, 312.

5 J. Witte-Orr, 'The mural decoration of the Lower City Church at Amorium', *Twenty-Eighth Annual Byzantine Studies Conference 4–6 October, 2002, The Ohio State University, Columbus, Ohio*, Columbus, 2002, 139–41.

6 Ivison (n. 4), 334–8; Lightfoot (n. 3), 295.

7 Ivison (n. 4), 336f, figs 31 and 32.

8 See the concordance in: M.A.V. Gill, *Amorium Reports Finds I: The Glass (1987–1997)*, with contributions by C.S. Lightfoot, E.A. Ivison, and M.T. Wypyski (BAR Int. Ser. 1070), Oxford, 2002.

9 Ibid., 223, nos 808–11, fig. 2/41.

10 R.M. Harrison, *Excavations at Saraçhane in Istanbul I: The Excavations, Structures, Architectural Decoration, Small Finds, Coins, Bones and Molluscs*, Princeton, 1986, 129f., nos 4.a.i-vii, figs 138–40, 414; S. Boyd, 'The champlevé revetments', in A.H.S. Megaw, *Kourion. Excavations in the Episcopal Precinct* (Dumbarton Oaks Studies XXXVIII), Washington DC, 2007, 235–97, esp. 236.

11 Gill (n. 8), 225–8, figs 2/42–3, pls 15–16; F. Dell'Acqua, 'Glass as part of Byzantine interior design', in E. Jeffreys *et al.*, *Proceedings of the 21st International Congress of Byzantine Studies London 21–26 August 2006*, Aldershot, 2006, 237–8.

12 E. Lafli and B. Gürler, 'Frühbyzantinische Glaskunst in Kleinasien', in F. Daim and J. Drauschke (eds), *Byzanz. Das Römerreich im Mittelalter. Teil I: Welt der Ideen, Welt der Dinge* (Monographien des RGZM 84.1), Mainz, 2010, 431–49, esp. 435.

13 Witte-Orr (n. 5).

14 Witte-Orr (n. 2), pl. P1.X/32; see the blue garment on fol. 142. A. Cutler, 'Makers and users', in L. James (ed.), *A Companion to Byzantium*, Oxford, 2010, 301–12, esp. 303, labels such stylistic studies as 'anachronistic'; it remains, however, remarkable how similar fresco and miniature are.

15 Witte-Orr (n. 2), 139.

16 The mosaic is located in the panel above the imperial door. See, http://www.pallasweb. com/deesis/leo-hagia-sophia.html for an online version of E.J. Hawkins, 'Further observations on the narthex mosaic in St. Sophia at Istanbul', *Dumbarton Oaks Papers* 22 (1968), 151–66.

17 P. Cox, 'The Lower City Church, Area A, Sector A2–A3', in C.S. Lightfoot *et al.*, 'Amorium excavations 1993. The sixth preliminary report', *Anatolian Studies* 44 (1994), 108–10, esp. 109; C.S. Lightfoot *et al.*, 'Amorium excavations 1994. The seventh preliminary report', *Anatolian Studies* 45 (1995), 105–37, esp. 116, fig. 6.

18 See the plan in Lightfoot *et al.* 1995 (n. 17), fig. 6.

19 See the photo in Ivison (n. 4), fig. 23.

20 H. Maguire, 'The medieval floors of the Great Palace', in N. Necipoğlu (ed.), *Byzantine Constantinople. Monuments, Topography and Everyday Life*, Leiden, 2001, 153–74, esp. 164, n. 29.

21 For the significance of *omphalia* and *rota* in general, see: G. Weber, *Kaiser, Träume und Visionen in Prinzipat und Spätantike* (Historia Einzelschriften 143), Stuttgart, 2000, 412, n. 282; Maguire (n. 20), 162ff; G. Dagron, *Emperor and Priest: The Imperial Office in Byzantium*, Cambridge, 2003, 93; P.C. Claussen, *Die Kirchen der Stadt Rom im Mittelalter 1050–1300*, Stuttgart, 2008, 322f; P. Schreiner, 'Omphalion und Rota Porphyretica. Zum Kaiserzeremoniell in Konstantinopel und Rom', in S. Dufrenne (ed.), *Byzance et les Slaves. Mélanges Ivan Dujčev*, Paris, 1979, 401–10.

22 Many thanks to D. Abuhatsira who calculated for me the surface dimensions from his reconstruction of the Lower City Church.

23 L. James, 'Byzantine glass mosaic tesserae: some material considerations', *Byzantine and Modern Greek Studies* 30/1 (2006), 29–47, esp. 44.

24 See Witte-Orr (n. 2), 152, table 4.

25 A. Kornerup and J.H. Wanscher, *Taschenlexikon der Farben*, Zurich and Göttingen, 1981.

26 J. Blair and N. Ramsay (eds), *English Medieval Industries: Craftsmen, Techniques, Products*, London, 2003, 128f.
27 C.S. Lightfoot, 'Trade and industry in Byzantine Anatolia: the evidence from Amorium', *Dumbarton Oaks Papers* 61 (2007), 269–86, esp. 283.
28 Y. Sablerolles, 'Beads of glass, faience, amber, baked clay and metal, including production waste from glass and amber bead making', in J.C. Besteman, J.M. Bos, D.A. Gerrets, H.A. Heidinga and J. De Koning, *The Excavations at Wijnaldum*, vol. 1, Rotterdam, 1999, 266; I.C. Freestone, J. Price and C.R. Cartwright, 'The batch: its recognition and significance', in K. Janssens, P. Degryse, P. Cosyns, J. Caen and L. Van't dack (eds), *Association Internationale pour l'Histoire du Verre. Annales du 17e Congrès Antwerp 2006*, Antwerp, 2009, 130–5, esp. 133.
29 P. Degryse, J. Schneider, U. Haack, V. Lauwers, J. Poblome, M. Waelkens and Ph. Muchez, 'Evidence for glass "recycling" using Pb and Sr isotopic ratios and Sr-mixing lines: the case of early Byzantine Sagalassos', *Journal of Archaeological Science* 33 (2006), 494ff.
30 V. Lauwers, 'Glass technology in late antiquity: a bibliographic note', in L. Lavan, E. Zanini and A. Sarantis (eds), *Technology in Transition A.D. 300–650* (Late Antique Archaeology 4), Leiden, 2007, 53–64, esp. 60.
31 L. Cunningham and J.R. Reich, *Culture and Values: Survey of the Humanities*, Belmont, 2005, 186.
32 F.B. Flood, *The Great Mosque of Damascus: Studies on the Makings of an Umayyad Visual Culture*, Boston, 2000, 24, speaks of ruined churches; C. Mango, *The Art of the Byzantine Empire 312–1453* (Medieval Academy Reprints for Teaching 16), Toronto, 1986, 123, 132.
33 Mango (n. 32), 132.
34 Flood (n. 32), 24.
35 Mango (n. 32), 181 (n. 1).
36 S. Franklin, *Writing, Society and Culture in Early Rus c. 950–1300*, Cambridge, 2002, 60f.; R.G. Ousterhout, *Master Builders of Byzantium*, University of Pennsylvania, 2008, 205.
37 Mango (n. 32), 221f.
38 James (n. 23), 33, 39.
39 Lauwers (n. 30), 60; Blair and Ramsay (n. 26), 180.
40 A nice illustration of the simple processes and set-up of glass working is Elliot Erwitt's 1977 documentary film *The Glass Makers of Herat, Afghanistan*.
41 Gill (n. 8), 105; V. Lauwers, P. Degryse and M. Waelkens, 'Evidence for Anatolian glass working in antiquity. The case of Sagalassos (Pisidia, SW Turkey)', *Journal of Glass Studies* 49 (2007), 39–46, esp. 43.
42 Wypyski (n. 2), 191.
43 Ibid., 191f.
44 E. Hendrix, 'Painted polychromy on carved stones from the Lower City Church', in Lightfoot (n. 2), 129–37, esp. 132.
45 I. Andreescu-Treadgold and J. Henderson, 'How does the glass of the wall mosaics at Torcello contribute to the study of trade in the 11th century?', in M. Mundell Mango (ed.), *Byzantine Trade, 4th–12th Centuries: the Archaeology of Local, Regional and International Exchange* (Papers of the Thirty-eighth Spring Symposium of Byzantine Studies, St John's College, University of Oxford, March 2004), Farnham, 2009, 393–420, esp. 393.
46 James (n. 23), 30ff.
47 Wypyski (n. 2), 189, however, analyzed the metals and found the gold to be 99% gold with less than 1% silver. See M. Mundell Mango, 'The monetary value of silver revetments and objects belonging to churches, A.D. 300–700', in S.A. Boyd and M. Mundell Mango (eds), *Ecclesiastical Silver Plate in Sixth-Century Byzantium* (Papers of the Symposium held 16–18 May 1986 at the Walters Art Gallery, Baltimore, and Dumbarton Oaks, Washington DC), Washington DC, 1992, 123–36, esp. 125–6, for a formula to calculate the total weight of the metals used in ceiling and mosaic decorations. Many thanks to Liz James for asking this important question.

Chapter 4
Mosaic Tesserae from the Basilica of San Severo and Glass Production in Classe, Ravenna, Italy

Cesare Fiori

Introduction

In AD 402, Ravenna became one of the centres of the imperial court when Emperor Honorius transferred the capital of the western Roman Empire from Milan to Ravenna. Its growing importance is indicated by the building of a series of infrastructures worthy of its rank and a remarkable, simultaneous urban expansion, which occurred between the 5th and 6th centuries.[1] Among the structures of greater significance is the port at Classe which, although it had already accommodated the barracks of the *classiari* for some centuries, underwent an extensive plan of reconstruction. As a harbour town close to Ravenna, Classe was soon provided with a defensive wall, churches and warehouses stocking commercial goods along the port's channel.[2] The port was active until about the middle of the 7th century when it fell into decline following the Lombard conquest. Recent surveys (2001–5) have allowed detailed clarification of the archaeological building sequence at Classe. Around the mid-5th century, some houses, most probably Roman *villae* built in the 2nd to 3rd century, were demolished freeing the space for a series of structures, recognizable as warehouses, which survived with some modifications until the 7th century. In the 8th century, the Lombards attacked the town, but life there continued and a nucleus of wooden houses was built in this area.[3]

Within the southern borders of Classe was the basilica dedicated to San Severo. Construction begun under Bishop Peter III, but its completion and consecration took place under Bishop John II in AD 592 or 593, which was a time of riots and conflict following the Lombard invasion in the northeast of Italy. The Byzantine government of Ravenna (exarchate) tried to confront the Lombards, but in AD 578 Classe fell to the Lombardic duke Faroald, who was most probably a rebel Byzantine commander. The building of the basilica was interrupted for a period of time until John II managed to complete the construction and move the saint's body and relics there. Additions to the internal decorations, fittings and maintenance works continued over time, but became more and more difficult during the 8th and 9th centuries. From the beginning of the 8th century, first under the Lombards and then under Frankish rule, the town of Classe began to decline.[4] The relics of San Severo were taken from the basilica and moved to Germany, first to the church of St Alban in Mainz and then to the church of St Paul in Erfurt. However, the saint's cult and links with his birthplace continued to flourish and in the second half of the 10th century, Emperor Otto I built a palace close to the monastery of San Severo; in this period a bell tower was added to the set of buildings. From then onwards, the Benedictine and Cistercian monks assumed care of the basilica and rare textual sources testify to important restoration work taking place in 1285. However, the sources describe such a bad state of conservation in 1469 that it became necessary for the lateral aisles and part of the central nave to be demolished. The monks moved from San Severo after 1512 and in the middle of the 18th century an attempt was made to re-occupy the ruins, which resulted in little improvement. At the beginning of the 19th century, only the ruins of the bell tower remained to indicate the place where the basilica had once stood.[5]

During the excavation of the basilica conducted by Giovanna Bermond Montanari in 1964, the foundation of the church and part of the floor mosaics were uncovered.[6] The basilica was of large dimensions (65 x 27m) with a rectangular plan that was composed of two aisles and a central nave, with a rectangular narthex at the entrance. Like other churches built in Ravenna in the 5th to 6th century, the apse had a polygonal shape on the outside and a semi-circular one inside. The basilica's interior was probably decorated with wall mosaics in the apse and in the presbytery since it is only in these areas that glass tesserae, some with gold leaf were found. The floor mosaics, realized in *opus tessellatum*, are the largest mosaic finds in northern Italy to date. They were subsequently removed and are now partially destroyed or lost.

Glass production in Classe

The archaeological survey conducted in the 1970s brought to light a kiln area which was identified as a pottery workshop.[7] Recent excavations have uncovered new remains that have allowed a better understanding of its real function. A large amount of glass waste and semi-manufactured glass products were collected close to a small semi-circular kiln, providing clear evidence for the presence of a glass working atelier. The material, 95% of which is from the end of the 5th and the first half of the 6th centuries, and dated by the typology of glass, is residual. The finds were mixed together in this period with numerous ceramic fragments, crushed stones and gravel, in order to raise the ground floor of a building.[8] Glass working activity continued until at least the middle of the 6th century.[9]

The vast majority of the glass material is, therefore, from a secondary context. Nonetheless, the presence of glass waste and semi-manufactured products is important evidence of a very rare diffuse production activity in Late Antiquity and in the Early Middle Ages. Because of the large amount of glass found, the importance of the site is significant and comparable only with a few other Italian sites such as the Crypta Balbi in Rome[10] and the Piazza della Signoria in Florence.[11] The site in Classe could possibly be interpreted as a secondary glass workshop, whilst the primary glass production centres at this time were located in the areas of Syria-Palestine and Egypt.[12]

The production waste ascribed to glass working make up a total weight of about 12kg, when one considers the semi-finished products, raw glass, cullet and skimming products.[13] Among the production waste, only a small percentage (0.8%) appears to be possibly interpreted as frits and skimming products. Further textural analyses would be necessary to conclusively recognize frit and to distinguish the fragments from glass mixed with dissolving clay or fuel ashes. In small quantities, however, they could lead to two possible interpretations. Whether it is definitely recognized as frit, it could have been imported together with raw glass or implies an attempt to produce glass in Classe, probably of a completely experimental nature.[14]

In Classe, chunks of raw glass and glass ingots amount to 8.7%. The cullet, in most cases represented by glass scrap melted together, totals 56% of the total amount of the production waste and this indicates the recycling of glass scrap, which would have played an important role in the production process by lowering the melting point.

Fluidity tests, drippings, bits, scrap and moils, comprising 29% of the total quantity of the production waste, represents the final step of glassware production: the blowing of the glass. Therefore, a glass-blowing furnace – not yet identified – must have been active for the production of glassware originating from the raw glass imported from the primary

Table 1a Chemical composition (wt%) of the glass production indicators from Classe

Sample	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	SnO_2	P_2O_5
FR	70.7	3.02	0.43	0.03	0.55	8.12	15.67	1.08	0.08	0.07	0.14
PVS	73.1	1.34	0.55	0.49	0.40	5.41	18.04	0.36	0.08	0.15	0.04
PVA	69.9	1.88	0.79	0.22	0.80	7.74	17.74	0.57	0.16	0.09	n.d.
PV	71.1	1.50	0.72	0.55	0.49	5.80	19.05	0.42	0.10	0.14	n.d.
C	63.2	3.03	3.28	1.80	1.45	6.20	19.03	0.50	0.51	0.68	0.12
T-A	66.1	1.71	0.69	0.11	0.81	9.05	20.41	0.67	0.16	0.09	0.04
TB	66.5	2.83	3.43	1.47	1.22	6.10	15.89	1.09	0.51	0.72	0.10
T-C	64.5	2.66	3.03	1.47	1.41	5.91	19.18	0.37	0.55	0.66	0.11
G1	72.3	1.51	0.59	0.10	0.67	6.94	16.45	1.03	0.15	0.14	0.05
G2	69.8	2.39	1.49	2.03	0.75	4.23	18.01	0.30	0.51	0.30	0.05
M1	70.0	2.26	1.32	1.38	0.87	5.10	17.75	0.47	0.37	0.26	0.05
M2	72.6	1.13	0.10	0.01	3.49	8.53	13.50	0.54	0.04	n.d.	n.d.
A1	75.7	2.81	0.23	0.04	0.91	6.31	12.87	0.96	0.06	n.d.	n.d.
A3	73.6	1.99	0.81	0.91	1.33	4.53	15.82	0.51	0.22	0.17	n.d.
G3	74.4	2.38	0.14	0.64	0.59	5.51	14.59	1.60	0.05	n.d.	n.d.
G4	70.8	2.40	1.01	0.93	1.51	5.34	16.45	1.05	0.19	0.19	0.02
C4	73.5	3.40	0.49	0.63	1.20	5.68	14.02	1.62	0.09	n.d.	n.d.
PF1	72.5	2.31	0.86	0.96	1.33	4.76	15.26	1.52	0.25	0.19	0.02
PF2	71.5	2.37	0.57	0.14	1.53	6.83	15.92	1.85	0.15	n.d.	0.02
F-D	68.0	2.94	2.35	1.08	1.34	6.33	16.17	0.45	0.60	0.51	0.07
FDD12	69.8	1.79	0.59	0.61	0.53	7.14	18.74	0.46	0.10	0.12	0.03

* FR=frit; PV=raw glass chunk, C=dripping, T=bit, G=lump, M=moil, A=agglomerate, PF=fluidity test, FD=deformed fragment

Table 1b Chemical composition (wt%) of the diagnostic glass fragments from Classe

Sample	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	SnO_2	P_2O_5
D18	74.1	3.02	0.30	n.d.	0.46	7.32	13.51	0.99	0.07	0.06	0.11
D1	65.3	3.20	2.85	1.53	1.24	5.90	17.41	0.48	0.57	0.59	0.14
D2	69.1	2.76	3.74	2.58	1.05	5.72	15.82	0.54	0.40	0.44	0.12
D3	69.5	2.62	2.73	1.78	0.71	4.76	16.85	0.40	0.26	0.51	0.12
D5	69.0	2.76	3.41	2.11	1.06	4.80	16.61	0.45	0.58	0.61	0.12
D7	71.4	2.11	2.03	0.26	0.34	4.58	16.97	0.55	0.11	0.40	0.05
D8	68.3	3.00	2.42	1.51	1.08	6.33	15.51	0.66	0.42	0.49	0.15
D10	70.7	1.66	0.61	0.61	0.50	5.60	19.51	0.40	0.10	0.12	0.05
D11	71.9	1.86	0.94	0.58	0.51	6.01	17.32	0.42	0.12	0.16	0.06
D14	72.5	1.20	0.28	0.47	0.40	5.71	18.71	0.34	0.07	0.08	0.05
D16	74.6	1.11	0.22	0.41	0.21	5.16	17.66	0.40	0.05	0.05	n.d.
D19	72.6	1.98	0.65	0.24	0.85	5.30	15.64	0.87	0.12	0.19	0.23
D20	68.8	3.05	2.61	1.44	1.70	5.20	16.21	n.d.	0.44	0.44	n.d.
D21	69.2	3.38	0.26	0.03	1.02	9.12	15.95	0.85	0.06	n.d.	n.d.
D22	68.3	2.51	0.90	1.63	1.79	7.14	16.55	0.64	0.15	0.22	n.d.
D23	73.3	2.39	0.50	0.75	0.86	4.59	16.82	0.52	0.18	n.d.	n.d.
D24	64.8	2.98	1.63	2.38	1.59	4.66	20.53	0.37	0.57	0.30	n.d.
D25	74.4	1.98	0.31	0.70	0.77	5.12	16.24	0.32	0.07	n.d.	n.d.
D26	69.9	3.50	1.73	0.11	1.42	4.48	17.51	0.39	0.37	0.34	0.35
D27	68.5	2.83	1.89	0.27	1.22	5.41	17.78	0.48	0.29	0.36	0.42
D28	69.7	2.77	1.70	1.97	1.49	4.61	15.05	0.37	0.50	0.34	n.d.
D29	69.4	2.40	1.00	1.27	2.07	5.00	17.55	0.38	0.27	0.21	n.d.
D30	70.5	2.95	1.94	0.11	1.53	4.44	17.73	0.38	0.65	0.36	0.16
D31	70.8	2.65	1.51	1.57	1.40	5.16	15.96	0.32	0.48	0.32	n.d.
D32	73.3	2.09	0.29	0.53	0.75	5.42	15.71	0.52	0.07	n.d.	n.d.
D33	74.9	2.36	0.39	0.47	0.89	6.08	15.43	0.72	0.08	n.d.	0.07
D34	67.3	2.98	1.83	1.36	1.72	5.02	18.95	0.35	0.45	0.34	n.d.
D35	72.2	1.64	0.20	0.03	0.53	4.46	15.72	0.35	0.06	n.d.	n.d.
D36	74.7	1.79	0.40	0.99	0.77	5.13	16.09	0.31	0.08	n.d.	n.d.
D37	71.4	1.47	0.55	0.82	0.81	6.45	17.24	0.32	0.08	n.d.	n.d.
D38	72.4	1.70	0.18	0.56	0.44	5.42	16.50	0.40	0.05	n.d.	n.d.
D39	70.5	2.59	1.59	1.74	1.42	4.96	14.99	0.30	0.49	0.32	n.d.

* Not negligible concentrations are present: PbO only in sample D7 (0.42%); Sb_2O_3 in D19 (0.23%), D32 (0.27%) and D35 (0.29%); CuO (0.39%) and D19 (0.89%); CoO in D7 (0.219%), D26 (0.125%), D27 (0.148%) and D30 (0.060%).

glass production sites with the possible addition of recycled glass and cullet. The presence of a furnace is also testified by the numerous bricks with a thick adhering layer of glass that have been found in the excavation campaigns, although there is no evidence for crucibles.

Analyses of the samples from Classe

Among the numerous glass finds, 53 samples have been chosen as representative of two distinct sets: diagnostic fragments and production indicators. The diagnostic fragments include the set of finds attributable to the final stage of the production process, in other words the final glass objects, such as drinking glasses, chalices, cups, bottles, lamps and sheets. The production indicators are those finds associated with a stage of the production activity: semi-manufactured products (raw glass blocks and frit) and production waste (cullet, drippings, bits, scrap, moils and fluidity tests).

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES – Varian Liberty 110 spectrometer equipped with an ultrasonic nebulizer to improve the detection limits) and Atomic Absorption Spectrometry (AAS – Perkin Elmer model analyst 600 Zeeman spectrophotometer) (analyses performed by Dr Genga, Department of Materials Science, Salento University) were employed to determine the chemical composition of the samples, reported in **Tables 1a** (production indicators) and **1b** (diagnostic fragments). The analyzed elements were: Na, Mg, Al, P, K, Ca, Ti, Mn, Fe, Co, Cu and Sn by ICP-AES and Cr, Sb and Pb, by AAS. The content of SiO_2 is determined by difference to 100. Accuracy is different for the various oxides: 3% for Na_2O and K_2O, 4% for CaO and Al_2O_3, 2% for MgO and PbO; 1% for CuO and SnO_2 (the latter was determined by the alkaline melting procedure), 5% for Fe_2O_3 and 10% for MnO. The precision for the other major constituents is between 1 and 2% while the minor constituents are in the range of 2–3% (data supplied in **Table 1a**). Those elements not reported in the table were below the limit of detection (in ppm: 0.04 for Co; 0.02 for Cu; 0.001 for Cr; 0.003 for Sb and Pb) or present at a level not relevant to the present work. Relevant data (of Co, Cu, Sb and Pb) is reported in the lower part of the table present at negligible levels.

The content of MgO and K_2O is employed to discriminate between natron or plant-ash glass – the two

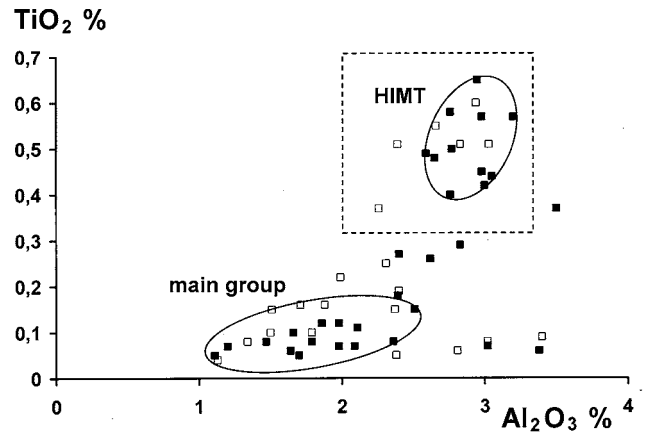


Figure 1 TiO_2 versus Al_2O_3 presenting the Classe samples ■= diagnostic fragments; □= production indicators. The square area represents an average range of literature data on HIMT glasses (see notes 19 and 20)

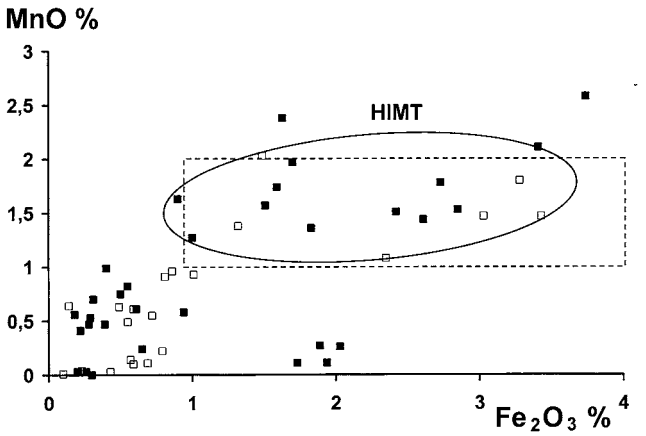


Figure 2 MnO versus Fe_2O_3 present in the Classe samples ■= diagnostic fragments; □= production indicators. The rectangular area represents an average range of literature data on HIMT glasses (see notes 19 and 20)

types of flux employed at that time in the Mediterranean area. The dispersion of the data appears evident: a more compact group of samples has low potassium oxide (less than about 0.5%) and magnesium oxide varies from very low levels to about 1.7%. All the samples can be considered to be made of natron glass, even though for some of them the content of the two oxides is slightly higher than about the 1% considered as an indication of the upper limit of concentrations. The highest contents of potassium oxide, exceeding 1.5%, are relative to four production indicators. As regards to the use of flux, a higher than average potassium content in the production indicators is the only feature distinguishing this set of samples from the group of diagnostic fragments. Those samples having a relatively higher content of MgO will be better described later as belonging to a particular set of samples. Also for CaO and Al_2O_3, employed to discriminate between different silica sources, the data appear quite dispersed (CaO: from 4.2% to 6.5% and Al_2O_3 from 1% to 3%). The majority of the samples with Al_2O_3 levels higher than 2.5% also have high magnesium.

A group of 14 samples (four production indicators: C, TB, T-C, F-D and ten diagnostic fragments: D1, 2, 5, 8, 20, 24, 28, 31, 34, 39), as well as the higher percentages of aluminium and magnesium oxides, all have in common higher contents of titanium, iron, manganese and tin oxides. The characteristic values of these samples are highlighted by the bold character in the tables. The diagrams TiO_2 versus Al_2O_3 (**Fig. 1**), MnO versus Fe_2O_3 (**Fig. 2**), report this peculiar compositional feature, which is also evident in the different contents of SnO_2 and TiO_2. Some other samples have similar characteristics, showing differences only for one or two of the above mentioned chemical parameters which characterize the group.

Due to the secondary context of the glass finds, the data dispersion is clearly noticeable and can be explained as follows. The existence of a local glass working centre in Classe, between the end of the 5th and the beginning of the 6th century, is definitely proved by the recovery of a small kiln, made of bricks with thick layers of glass, production tests and scrap. The variety of glass material (imported raw glass, cullet, scrap and waste of various possible provenances) found in the excavation and possibly employed in variable proportions makes the definition of a specific character of the glass a complicated task. On the one hand, the geographical origin of the glass fragments could be quite heterogeneous but, on the other, their chronological definition is much more restricted to the period around AD 500, even though the presence of earlier material cannot be completely excluded. In the Mediterranean during that time period, the production of glass was characterized by the use of natron as a source of flux: the typical composition of natron glass contains low percentages of potassium and magnesium oxide (less than about 1–1.5%). Some of the samples studied in this work have the definite characteristic of natron glass while other samples have slightly higher contents of the two oxides, although they do not belong to the category of plant-ash glass, a later type of glass, characterized by higher contents of the two oxides.[15] In our sample set, the highest content of K_2O is characteristic of a small group of production indicators and can be due to a contamination of the melt, possibly from the potassium-rich vapour from the wood fuel used to fire the furnace.[16] Higher contents of MgO, on the contrary, do not appear to be simply due to secondary contamination since the majority of the samples with relatively high MgO present higher levels of Al_2O_3 and TiO_2. This can be attributed to the use of different raw materials. In particular, the content of titanium recalls the glass typology known as HIMT (High Iron Manganese Titanium) diffused throughout the Mediterranean and Europe from the 4th century onwards, originally recognized by Ian Freestone in glass samples analyzed from Carthage. Although the origin of the HIMT type of glass is still unclear, glasses from Italy, Germany and England also belong to this same category. In the eastern Mediterranean, this type of glass is particularly widespread in the northern Sinai area, while it is scarce in Israel where the presence of the Levantine I type dominates. Glasses of the Levantine I type are typical of the Levant between the 4th and 7th centuries and can be identified with Byzantine production (6th to 7th century) in Israel[17] as well as Roman production (4th century) in Jalame, the site of a Late Roman

glass factory in Palestine.[18] This type of glass, which dominated production during the Byzantine period in northern Israel, used a type of sand from the Belus delta (Bay of Haifa) on the Palestinian coast. These coastal sands contain calcareous fragments (seashells) that supplied sufficient lime to function as a stabilizer while the soda flux was provided by natron. The HIMT glass is clearly distinguished by its yellow-green colour while Levantine I is pale blue. Recent analyses[19] show that Levantine I and HIMT were the two prevailing and competing categories in the Mediterranean area between the 5th and 7th centuries.[20]

Fourteen samples of the set from Classe can be classified as HIMT glasses in which higher contents of aluminium, magnesium and tin oxide can also be observed. The flux for these glasses is natron but the distinction from the Levantine I type is made on the basis of the use of a less pure silicatic source containing higher quantities of Al, Fe, Mg and Ti and by the addition of manganese as a decolouring agent to neutralize the effect of iron. The typical composition of the HIMT glasses from Classe can be summarized as follows: SiO_2: 64–70%; Al_2O_3: 2.5–3.3%; TiO_2: 0.25–0.7%; CaO: 4–6%; MgO: 1–2%; Na_2O: 15–20%; K_2O: 0.3–0.6%; Fe_2O_3: 1–3.5%; MnO: 1–2.5%; SnO_2: 0.25–0.7%; PbO: not detectable. It is very interesting to note the presence of tin, even in low but significant amounts, in a period that witnessed the advent of tin oxide as a glass opacifier.

Although the two competitive types in this period were HIMT and Levantine I, the characteristic of the latter (i.e. relatively high content of CaO around 8–9%, Al_2O_3 around 2.5–3% and the negligible content of manganese) can be found only in three samples from Classe (two diagnostic fragments D18 and D21) and in the sample possibly recognized as frit (FR). On the basis of the contents of the above mentioned oxides, together with that of the alkali and of MgO, the remaining samples form a separate group, characterized by a relatively low content of CaO, with features more typical of earlier Roman glass decoloured with manganese from the period of the 1st to the 4th century;[21] these samples, therefore, could be considered as the cullet of previously produced glass, interestingly noting that this group includes a raw glass chunk (sample PVS), from which the vessels could have been produced.

It is therefore possible that in the period of glass working activity in Classe both contemporary glass (prevalently HIMT glass, given that the presence of the Levantine I type of glass is quite scarce) and older glass cullet was alternatively employed or mixed. In some samples, in fact, it is possible to recognize intermediate compositions. Nonetheless, the identification of HIMT glass in Classe is very interesting since it confirms its diffusion in Europe, leading one to reconsider the possibilities of trade between Classe, the Levant and western Europe.

Mosaic tesserae from the archaeological area of San Severo (Classe)

Glass tesserae were recovered in various excavation campaigns in the archaeological area of the basilica and the monastery of San Severo. A first set of analyses was conducted in the 1990s and only partially published together with data on glass mosaic tesserae from Ravenna.[22]

Analyses of the mosaic glass from the archaeological area of San Severo

The composition of 15 tesserae previously analyzed by X-ray Fluorescence Spectrometry (XRF-WDS) is reported in **Table 2a**; another set of 23 tesserae was recently analyzed by Electron Microprobe Analysis (EMPA-WDS) (analyses performed by Dr Arletti at the Department of Earth Science, University of Modena and Reggio Emilia) and the results are reported in **Table 2b**.

XRF-WDS analyses were carried out on abundant samples (weight > 0.5 g), employing a PW1480 wavelength dispersion spectrophotometer; pellets were prepared by adding a binder (water solution of polyvinyl alcohol) to the powdered sample and by pressing the mix on a support of boric acid. The elements analyzed were: Na, Mg, Al, Si, P, K, Ca, Ti, Cr, Mn, Fe, Co, Cu, Sn, Sb and Pb. The accuracy ranges from 3 to 5%. The precision for the major constituents is between 1 and 5% while the minor constituents are in the range 5–20%. For those elements indicated as not detected (n.d.) in **Table 2a**, the limits of

Table 2a Chemical composition (wt%) of the mosaic glass from San Severo (XRF data)

Sample	SiO_2	Al_2O_3	TiO_2	MnO	MgO	Fe_2O_3	CaO	Na_2O	K_2O	Sb_2O_3	CuO	PbO	SnO_2	CoO	Cr_2O_3	P_2O_5	Total
White	65.92	1.60	0.06	0.04	3.96	0.41	6.60	13.56	0.62	4.54	n.d.	n.d.	0.01	n.d.	n.d.	0.03	97.35
Light blue	67.96	2.22	0.08	0.45	0.59	0.66	6.09	12.99	0.81	5.03	0.02	0.05	0.02	0.025	n.d.	0.13	97.13
Light blue	70.02	2.21	0.10	0.51	0.57	0.71	5.79	14.87	0.76	1.05	0.02	n.d.	0.01	0.025	n.d.	0.11	96.76
Dark blue	69.10	1.94	0.08	0.20	0.61	0.87	5.60	15.24	0.65	2.13	0.08	0.04	0.01	0.05	n.d.	0.06	96.66
Blue	69.44	1.70	0.11	0.03	0.46	0.81	4.45	14.97	0.53	0.81	3.12	n.d.	0.12	n.d.	n.d.	0.03	96.58
Turquoise	68.69	1.80	0.14	0.03	0.47	0.74	3.64	14.30	0.54	2.82	3.00	0.41	0.16	n.d.	n.d.	0.03	96.77
Grey green	68.20	2.39	0.11	0.40	0.61	0.75	6.07	14.50	0.83	1.49	1.36	0.04	0.07	n.d.	n.d.	0.10	96.92
Green	68.60	2.33	0.08	0.67	0.60	0.62	6.72	13.52	0.80	2.33	0.69	0.13	0.06	n.d.	n.d.	0.10	97.25
Black	66.85	2.32	0.05	2.17	0.62	0.53	7.49	15.76	0.78	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.09	96.66
Black blue	66.04	2.23	0.14	1.21	1.03	1.43	7.97	15.54	0.80	n.d.	0.01	0.03	0.03	0.05	n.d.	0.11	96.62
Transparent	69.84	1.92	0.08	0.53	0.68	0.58	6.43	15.79	0.43	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.03	96.31
Turquoise	68.64	2.28	0.13	0.04	0.94	0.75	5.89	15.41	0.43	n.d.	1.05	0.42	0.55	n.d.	n.d.	0.03	96.56
Light blue	69.98	2.63	0.07	0.05	0.67	0.46	7.99	13.13	0.78	n.d.	0.89	0.37	0.36	n.d.	n.d.	0.09	97.47
Yellow	66.87	2.30	0.06	0.05	0.63	0.70	6.61	12.75	0.54	0.23	0.05	7.89	n.d.	n.d.	n.d.	0.08	98.76
Red	63.25	2.14	0.20	0.85	1.03	2.24	6.78	11.91	1.17	n.d.	2.17	5.18	1.78	0.025	n.d.	0.31	99.04

Table 2b Chemical composition (wt%) of the mosaic glass from San Severo (WDS-EMPA data)

Sample	SiO_2	Al_2O_3	TiO_2	MnO	MgO	Fe_2O_3	CaO	Na_2O	K_2O	Sb_2O_3	CuO	PbO	SnO_2	CoO	Cr_2O_3	P_2O_5	Total
Light green	59.54	1.79	0.12	0.02	0.74	0.43	5.88	18.00	0.35	0.01	0.88	8.17	1.03	n.d.	0.01	0.03	97,00
Light green	61.10	1.80	0.11	0.01	0.80	0.47	6.30	18.28	0.35	0.02	0.85	6.43	0.75	n.d.	0.01	0.05	97.33
Light green	65.69	2.30	0.07	0.36	0.56	0.61	7.25	18.04	0.68	0.36	2.14	0.66	0.09	n.d.	0.03	0.18	99.02
Green	60.37	1.71	0.11	0.06	0.71	0.50	5.44	16.99	0.30	0.02	1.12	9.04	1.44	0.01	0.01	0.05	97.88
Green	63.28	1.92	0.24	0.10	0.62	1.61	6.54	15.38	0.38	0.01	2.36	4.67	0.41	n.d.	0.01	0.02	97.55
Green- l.blue	61.95	1.86	0.12	0.03	0.73	0.58	5.63	18.47	0.33	0.03	1.18	6.59	0.92	0.01	0.02	0.01	98.46
Green- l.blue	65.55	2.25	0.10	0.69	0.54	0.54	6.35	17.25	0.76	0.79	2.34	1.57	0.12	0.01	0.02	0.12	99.00
Dark green	64.80	2.26	0.11	0.54	0.54	0.54	5.81	17.21	0.75	1.12	4.36	0.50	0.21	0.01	0.01	0.07	98.84
Op.l.blue	64.59	2.31	0.11	0.71	0.60	0.41	8.08	14.98	0.70	4.85	0.17	0.14	0.02	0.01	0.01	0.16	97.85
Op.l.blue	66.95	2.05	0.09	0.66	0.47	0.40	5.94	17.91	0.63	2.35	1.16	0.31	0.08	n.d.	0.01	0.09	99.10
Op.l.blue	66.95	2.25	0.08	0.66	0.53	0.40	6.50	16.14	0.71	2.35	2.51	0.46	0.31	0.01	0.01	0.11	99.98
Turq.blue	67.05	2.13	0.13	0.18	0.78	0.47	4.56	19.79	0.56	1.57	2.39	0.20	0.13	n.d.	0.01	0.08	100.03
Purple	60.51	2.21	0.07	0.49	0.46	0.94	8.78	13.90	0.64	9.92	0.36	n.d.	n.d.	0.11	n.d.	0.09	98.48
Turquoise	70.39	2.54	0.16	0.02	0.89	0.53	9.77	13.47	0.78	0.47	0.01	n.d.	n.d.	0.01	0.07	0.11	99.22
Transparent	67.18	2.39	0.14	0.03	0.84	0.57	9.25	15.59	0.86	0.40	0.02	n.d.	0.01	0.01	0.01	0.08	97.38
Transparent	70.35	1.99	0.10	0.08	0.47	0.31	6.07	17.70	0.54	0.89	0.07	0.12	0.01	n.d.	0.02	0.10	98.82
Transparent	68.97	2.04	0.08	0.30	0.44	0.27	5.42	20.53	0.51	0.58	0.02	0.04	n.d.	n.d.	0.01	0.07	99.28
Transparent	68.90	1.79	0.09	0.15	0.36	0.27	5.35	19.84	0.51	0.65	0.07	0.14	0.01	0.03	n.d.	0.05	98.21
Transparent	64.44	2.31	0.13	0.01	0.59	0.50	8.00	20.25	0.56	1.50	n.d.	0.06	n.d.	0.01	0.01	0.06	98.43
Transp. green	66.26	2.11	0.11	1.32	0.56	0.50	6.75	18.11	0.48	0.03	0.02	0.08	0.01	0.01	0.03	0.05	96.43
Red	53.91	2.41	0.21	1.13	1.02	1.86	7.34	14.67	1.11	0.10	2.15	7.55	3.02	0.01	0.01	0.35	96.85
Brick red	59.61	2.50	0.18	0.78	0.96	1.66	8.18	15.59	1.08	0.05	1.54	4.74	1.81	n.d.	0.01	0.29	98.98
Brick red	57.41	2.47	0.20	1.15	1.08	1.50	7.95	16.76	1.04	0.07	1.98	5.03	2.31	0.02	0.01	0.26	99.24

detection were 0.001% for Co and Cr – the latter always below the detection limit; 0.01% for Cu; 0.005% for Sn and 0.05% for Sb and 0.03% for Pb.

EMPA-WDS analyses were carried out on polished samples using an ARL-SEMQ electron microprobe equipped with four scanning wavelength spectrometers. The elements analyzed were: Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Co, Cu, Sn, Sb and Pb. Several points were analyzed on each sample to test homogeneity, and the mean value of all the measurements was calculated. The measuring accuracy for the analyzed elements was lower than 3%, while the precision for major constituents was between 1 and 2% while for the minor constituents it was in the range of 2–3%. Detection limits for the analyzed elements were higher than 0.05% and, for the minor constituents, comparable to that of XRF-WDS.

The two sets of data are very similar, apart from the content of sodium oxide that, on average, appears to be slightly lower in the sample set analyzed by XRF. This could be an actual difference but the discrepancy is usually interpreted as a result of the different sample preparation, use of standards and the known difficulties in detecting light elements, such as sodium, by XRF, confirmed by the low sum of the oxide percentages of the analyses (see **Table 2a**). The discrepancy in the values of sodium oxide, although not to be neglected, does not invalidate the glass classification; therefore it was decided that all data should be treated on a general base for classification purposes.

In the binary diagram MgO versus K_2O (**Fig. 3**), the field containing the majority of the data of the tesserae from San Severo perfectly matches that of the mosaic glass from other basilicas in Ravenna (field 2).[23] However, the data only partially mirrored the compositional field of the glass from Classe (field 1), although the composition of the tesserae from San Severo is only similar to that of the glasses with the lowest content of potassium and magnesium. A third field (field 3) is occupied by the group of red glasses, located in a section of the graph where only a part of the scattered data of the production indicators does not signify a correspondence with the mosaic glass. Considering the amounts of CaO and Al_2O_3, there is a strong correlation between the tesserae from San Severo with the typical mosaic glass from Ravenna and a partial correspondence with the characteristics of the glass from Classe, only for those samples with relatively low calcium and aluminium oxides. Most of the mosaic glass, however, presents higher amounts of calcium oxide, presenting intermediate characteristics between the Roman and the Levantine I type as regards to the use of the silica source.

The presence of MgO, Al_2O_3, TiO_2 and Al_2O_3 (**Fig. 4**) is therefore evidence that these glass samples were different from the mosaic glasses of the HIMT type found at Classe, while a correspondence can be found between the tesserae from San Severo and the group of glasses from Classe with the characteristics of Roman glass.

In studying the origin of the colour in the tesserae from San Severo, a distinction can be made between lead-rich and unleaded tesserae. The green, green/light blue, yellow and red tesserae are lead-rich glasses. The green glasses were achieved by the addition of copper, in the presence of lead stannate in most cases (**Table 2b**). The yellow is due to the co-presence of lead and low levels of antimony (it is the only case of a significant amount of antimony in a lead-rich matrix, possibly forming lead antimonate) as well as iron, giving a yellowish translucent tint. The red colour is due to copper under reducing conditions (see below), favoured also

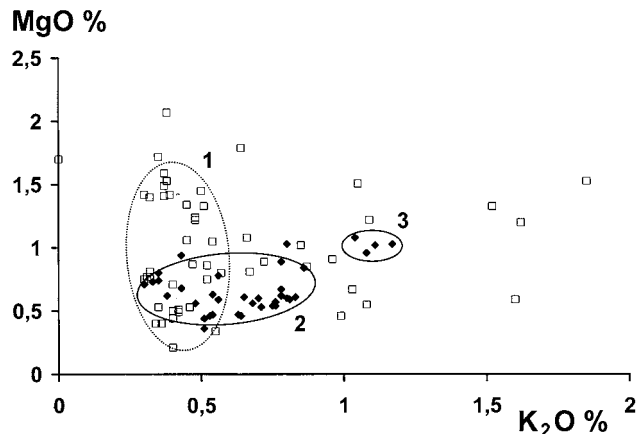


Figure 3 MgO versus K_2O present in: ♦ = mosaic tesserae from San Severo; □ = glasses from Classe; 1 = main group of the glasses from Classe; 2= tesserae of various colours from San Severo; 3 = red tesserae from San Severo

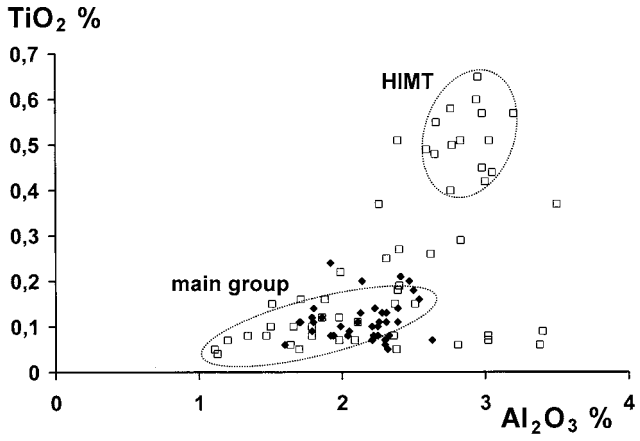


Figure 4 TiO_2 versus Al_2O_3 present in: ♦ = mosaic tesserae from San Severo; □ = glasses from Classe

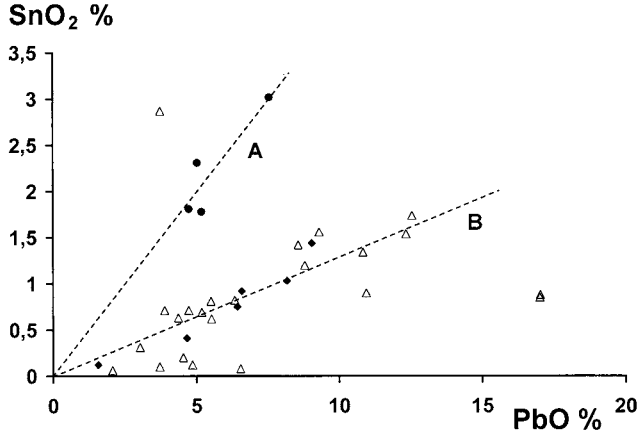
by the presence of iron. In most of the lead-rich glasses tin is also present, while the other opacifier – antimony – is detectable only in the yellow tessera (**Table 2a**), although it is a low amount. The presence of tin seems to be connected to that of lead, both probably introduced as metallic wastes. Although tin oxide was first introduced as an opacifier as early as the 2nd century BC, it is during the 4th century that tin-based opacifiers started to replace the antimony based opacifiers from the eastern Mediterranean through into northern Europe. Tin-based opacifiers were also used in Italy from the 5th century onwards, but at the same time antimony based opacifiers continued to be used (or re-used) and disappeared around the 13th century.[24] In the tesserae from San Severo the two opacifiers were employed in conjunction with one another and selected to obtain different colours: tin is generally introduced in lead-rich glasses, while antimony is present in lead-free tesserae (one exception is the yellow tessera), as described below.

Among the lead-free tesserae, the blue and the light blue are coloured with cobalt and a turquoise tessera with copper; these glasses (and some of the green-light blue) are opacified with antimony. Some of the transparent glasses were decolourized with antimony – a method used in the older Roman glass – while manganese was employed as a decolouring agent in only one tessera. Relatively high contents of manganese and iron produced the 'black' and purple colours. The white tessera was obtained through the use of antimony as an opacifier in the form of calcium antimonate. The unusual presence of MgO could be indicative of the use of talc to increase the glass opacity[25] since it would lead to the formation of magnesium silicate crystals giving opacity and a matte surface. Textural and/or XRD analyses are needed to verify this hypothesis. Another peculiar composition is that of a purple tessera containing almost 10% of antimony oxide and a relatively high content of cobalt (CoO > 0.1%) where reducing conditions and the co-presence of iron could have determined the final colouration (blue due to iron and pink due to cobalt).

The peculiar composition of the red glasses is worth looking at further. Apart from the association of lead, colourants and opacifiers, they are characterized by relatively high contents of potassium and magnesium, even though the levels are not enough to be related to the use of plant ash as a source of flux. They still belong to glasses of the natron type, with the probable addition of vegetal fuel ash (wood ash) during the melting process. This is supported also by the presence of a higher content of phosphorous, which is not detectable in the rest of the sample set. Studies of Iron Age, Roman and Byzantine red opaque glasses[26] have indicated the use of copper-lead-silica silver-refining slag, or its associated litharge, to obtain some of this red glass. In the red mosaic glasses from Ravenna in general, and particularly from San Severo, there is no correlation between lead and copper. Copper was therefore introduced independently of lead, while the correlation between lead and tin (**Fig. 5**) recalls the use of lead debris together with pewter scrap as found in the lead-rich tesserae from the basilica of San Vitale.[27]

These metallic scraps favoured the reducing conditions of the melt and the formation of cuprite or metallic copper, which was responsible for the brilliant red colour. The reducing conditions were also facilitated by the addition of combustible ashes, revealed by the relatively high contents of potassium, magnesium and phosphorous oxides. Lead-free

Figure 5 SnO_2 versus PbO present in the mosaic tesserae of Δ = San Vitale; ♦ = San Severo; ● = red tesserae from San Severo; A = low PbO/SnO_2 ratio about 2.5; B = high PbO/SnO_2 ratio about 8



red glass can also be found among the mosaic tesserae from Ravenna with 'normal' contents of potassium, magnesium and phosphorous oxides. In these glasses relatively high amounts of iron have favoured the reducing conditions. In the red mosaic glasses from San Severo, the correlation SnO_2 vs. PbO (**Fig. 5**) indicates a lower lead to tin ratio corresponding to the use of an alloy with Pb:Sn in the ratio of 2:1 (corresponding to that of pewter). It is worth noting that red tesserae from San Vitale show similar characteristics. In the remaining group the correlation between lead and tin is analogous to that of the green and yellow (and a few red) tesserae from San Vitale. In a recent work, Tite and colleagues examined tin-opacified glass and proposed a reassessment of the method by which these materials may have been produced.[28] They demonstrated that in a mixture of SiO_2, PbO and SnO_2 the persistence of $PbSnO_3$ is favoured by low PbO/SnO_2 ratios and low levels of silica. Otherwise the cubic lead stannate, responsible for the yellow colour, would be transformed into cassiterite at relatively low temperatures (around 750–850°C), preventing the formation of the desired shade. In the case of the green and yellow tesserae from San Severo, the high PbO/SnO_2 ratio would imply relatively low temperatures to prevent the conversion of lead stannate to cassiterite. A similar situation is reported by Tite and colleagues relative to *opus sectile* and mosaic tesserae from the eastern Mediterranean.

Conclusion

Excavations have provided evidence of possible glass production during the 5th to 6th century in Classe. This period witnessed the construction of Byzantine basilicas in Ravenna with their magnificent glass mosaic decoration, a rich palette of colours and the special use of gold and silver foil tesserae. The mosaic glass could have been produced *in loco* or imported from the Levant. The discovery in Classe of glass finds indicative of local glass manufacture has stimulated the comparison between the two glass sets from the site: one from the supposed production area, the other of glass tesserae from San Severo's archaeological area.

The study of the semi-manufactured and finished products found in Classe has led to the conclusion that secondary production was based on the use of raw glass and cullet of a low iron Roman natron glass type and HIMT glasses. While HIMT glasses were widespread in the Mediterranean area and in Europe at the same time as the glass production activity, the Roman glass could have been produced with the prevailing use of glass scrap and waste from a preceding period, or simply be residual material from earlier times.

The base characteristic mosaic glass from the archaeological area of San Severo corresponds to types of mosaic glasses from other Byzantine basilicas in Ravenna. This leads to the hypothesis of a single source of glass supply for the decoration of the basilicas during the 5th and 6th centuries. Natron glass was produced with calcareous sands, possibly of Levantine origin, which had intermediate chemical characteristics with Roman and Levantine I types of glass as regard to the vitrifying raw material. From the chemical point of view, this source was distinct from the glass working activity recognized in Classe. In the mosaic glass the presence of colourants, opacifiers (and lead in 11 tesserae) is the most distinctive characteristic, but the base raw materials also seem to be different. The red tesserae from San Severo makes a separate group which is characterized by higher contents of potassium, magnesium and phosphorous with respect to the natron type glass to which all the above-mentioned categories belong. The production of red glass obtained through copper being used as the main chromophore required a particular technology, which implies the addition of a substance of possible vegetal origin. In the lead-rich red mosaic glasses from San Severo (and from other sites in Ravenna), copper was introduced independently of lead and tin since there is no correlation. On the contrary, the correlation between lead and tin, although with two different ratios, suggests the use of lead – tin debris and pewter scrap. This scrap favoured the reducing conditions of the melt for the formation of cuprite or metallic copper, responsible for the brilliant red colour. The reducing conditions were also facilitated by the addition of combustible ashes, revealed by the relatively high contents of potassium, magnesium and phosphorous oxides.

From the chemical point of view, the lack of the HIMT type amongst the mosaic glass, and the scarce correspondence of the chemical data of the two sets of glasses from Classe and San Severo, does not support a link between the supposed glass production in Classe and the mosaic tesserae.

Acknowledgements

The author wishes to thank Dr Rossella Arletti (University of Turin) for the EMPA-WDS analyses and Dr Alessandra Genga (University of Salento) for the ICP-AES and AAS analyses. Some of the glass samples were collected during the excavation campaigns directed by Professor A. Augenti (Department of Archaeology, University of Bologna).

Notes

1 S. Gelichi, 'Ravenna, ascesa e declino di una capitale', in G. Ripoll and J.M. Gurt (eds), *Sedes Regiae (ann. 400–800)* (Reial Academia des Bones Lletres, Barcelona), Barcelona, 2000, 109–34.

2 A. Augenti, 'Ravenna e Classe: archeologia di due città tra tarda Antichità e l'alto Medioevo', in A. Augenti (ed.), *Le città italiane tra la tarda antichità e l'alto Medioevo, Atti del convegno* (Ravenna, 26–8 febbraio 2004), Florence, 2006, 185–217.

3 A. Augenti, 'Ravenna e Classe: il racconto di due città, tra storia e archeologia', in A. Augenti and C. Bertelli (eds), *Santi Banchieri Re. Ravenna e Classe nel VI secolo. San Severo e il tempio ritrovato*, Milan, 2006, 17–22; A. Augenti, M. Bondi, M. Carra, E. Cirelli, C. Malaguti and M. Rizzi, 'Indagini archeologiche a Classe (scavi 2004): primi risultati sulle fasi di età alto-medievale e dati archeobotanici', in R. Francovich and M. Valenti (eds), *Atti del IV Congresso di Archeologia Medievale* (Abbazia di San Galgano, Chiusdino-Siena, 26–30 settembre 2006), Florence, 2006, 124–31.

4 N. Christie, 'La chiesa e i mausolei', in A. Augenti (ed.), *La basilica e il monastero di San Severo a Classe. La storia, gli scavi*, Ravenna, 2006, 11–14.

5 Ibid.

6 G. Bermond Montanari, 'Scavi e ricerche nella zona della basilica di S. Severo', *Bollettino Economico della Camera di Commercio di Ravenna* XXI (1966), 12–18; G. Bermond Montanari, *La chiesa di San Severo nel territorio di Classe*, Bologna, 1968.

7 M.G. Maioli, 'Strutture economico-commerciali e impianti produttivi nella Ravenna bizantina', in A. Carile (ed.), *Storia di Ravenna. II. Dall'età bizantina all'età ottoniana. Territorio, Economia e Società*, Venice, 1991, 223–47.

8 S. Tontini, 'Vetri e produzione vetraria a Classe (Ravenna) in età tardoantica e altomedievale', *Bulletin* 15 (2006), 45–53.
9 E. Cirelli and S. Tontini, 'Produzione vetraria a Classe nella tarda antichità', in M. Vandini (ed.), *Riflessioni e trasparenze: diagnosi e conservazione di opere e manufatti vetrosi. Atti del convegno AIAr* (Ravenna, 24–6 febbraio 2009), Bologna, 2010, 125–33.
10 L. Saguì and P. Mirti, 'Produzioni di vetro a Roma nell'alto medioevo: dati archeologici e archeometrici', in D. Foy and M.-D. Nenna (eds), *Échanges et commerce du verre dans le monde antique. Actes du colloque de l'AFAV* (Aix-en-Provence and Marseille, 7–9 juin 2001), Montagnac, 2003, 87–91.
11 G. De Marinis, 'Resti di lavorazione vetraria tardo-romana negli scavi di Piazza della Signoria a Firenze', in M. Mendera (ed.), *Archeologia e storia della produzione del vetro preindustriale. Atti del convegno internazionale: L'attività vetraria medievale in Valdelsa e il problema della produzione preindustriale del vetro: esperienze a confronto*, Florence, 1991, 55–65.
12 D. Foy, 'Technologie, géographie, économie. Les ateliers de verriers primaires et secondaires en Occidente. Esquisse d'une évolution de l'Antiquité au Moyen Âge', in M.-D. Nenna (ed.), *La Route du Verre: Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen-Age* (Travaux de la Maison de l'Orient Méditerranéen no. 33), Lyon, 2000, 147–70; D. Foy, M. Picon and M. Vichy, 'Les matières premières du verre et la question des produits semi-fini. Antiquitè et Moyen Âge', in P. Pétrequin *et al.* (eds), *Arts du feu et productions artisanales, XXe Rencontres Internationales d'Archeologie et d'Histoire d'Antibes*, Antibes, 2000, 419–31; M. Picon, 'La révélation des analyses', in D. Foy and M.-D. Nenna (eds), *Tout feu tout sable. Mille ans de verre antique dans le Midi de la France*, Marseille, 2001, 32–3; M. Picon and M. Vichy, 'D'Orient en Occident: l'origine du verre à l'époque romaine et durant le haut Moyen Âge', in Foy and Nenna (n. 10), 17–31.
13 Tontini (n. 8).
14 Cirelli and Tontini (n. 9).
15 C. Lilyquist and R.H. Brill, *Studies in Ancient Egyptian Glass*, Metropolitan Museum of Art, New York, 1993.
16 S. Paynter, 'Experiments in the reconstruction of Roman wood-fired glassworking furnaces: waste products and their formation processes', *Journal of Glass Studies* 50 (2008), 271–90.
17 I.C. Freestone, Y. Gorin-Rosen and M.J. Hughes, 'Primary glass from Israel and the production of glass in late antiquity and the early Islamic period', in Nenna (n. 12), 65–84.
18 R.H. Brill, 'Scientific Investigations', in G.D. Weinberg (ed.), *Excavations at Jalame: Site of a Glass Factory in Late Roman Palestine*, Columbia, 1988, 257–94; M.-D. Nenna, M. Vichy and M. Picon, 'L'atelier de verrier de Lyon, du Ier siècle après J.-C., et l'origine des verres "romains"', *Revue d'Archéométrie* 21 (1997), 81–7.
19 I.C. Freestone, R. Greenwood and Y. Gorin-Rosen, 'Byzantine and early Islamic glassmaking in the eastern Mediterranean: production and distribution of primary glass', in G. Kordas (ed.), *1st International Conference: Hyalos-Vitrum-Glass. History, Technology and Conservation of Glass in the Hellenic World*, Athens, 2002, 167–74; I. C. Freestone, M. Pointing and M. J. Hughes, 'The origins of Byzantine glass from Maroni Petrera, Cyprus', *Archaeometry* 44/2 (2002), 257–72.
20 P. Degryse, J. Schneider, J. Poblomec, M. Waelkens, U. Haack and P. Muchez, 'A geochemical study of Roman to early Byzantine glass from Sagalassos, south-west Turkey', *Journal of Archaeological Science* 32 (2005), 287–99; I.C. Freestone and F. Dell'Acqua, 'Early medieval glass from Brescia, Cividale and Salerno, Italy: composition and affinities', in D. Ferrari (ed.), *Il vetro nell'alto medioevo, Atti delle VIII Giornate Nazionali di Studio, Spoleto 20–21 Aprile 2002*, Imola, 2005, 65–75; I.C. Freestone, S. Wolf and M. Thirlwall, 'The production of HIMT glass: elemental and isotopic evidence', in *Annales du 16e Congrès de l'Association Internationale pour l'Histoire du Verre*, AIHV, London, 2005, 153–7; A. Silvestri, G. Molin and G. Slaviulo, 'Roman and medieval glass from the Italian area: bulk characterization and relationship with production technologies', *Archaeometry* 47/4 (2005), 797–816; M. Verità, 'Analisi di reperti vitrei e scarti di lavorazione di tarda età romana provenienti dagli scavi del monastero di Santa Giulia a Brescia', in G.P. Brogiolo (ed.), *S. Giulia di Brescia gli scavi dal 1980 al 1992. Reperti preromani, romani e alto medievali*, Florence, 1999, 309–14; H.E. Foster and C.M. Jackson, 'The composition of 'naturally coloured' late Roman vessel glass from Britain and the implications for models of glass production and supply', *Journal of Archaeological Science* 36 (2009), 189–204; H.E. Foster and C.M. Jackson, 'The composition of late Romano-British colourless vessel glass: glass production and consumption', *Journal of Archaeological Science* 37 (2010), 3068–80; R. Arletti, G. Vezzalini and S. Benati, 'Roman coloured and opaque glass: a chemical and spectroscopic study', *Archaeometry* 52 (2010), 252–71; D. Foy, M. Picon and V. Thiron-Merle, 'Caractérisation des verres de la fin de l'Antiquité en Mediterranée occidentale: l'émergence de nouveaux courants commerciaux', in Foy and Nenna (n. 10), 41–85; F. Gallo, 'Glass in the northern Adriatic area from the Roman to medieval period: a geochemical approach for provenance and production technologies', PhD thesis, University of Padua, 2012.
21 Nenna *et al.* (n. 18); M.-D. Nenna, M. Picon and M. Vichy, 'Ateliers primaires et secondaires en Ègypt à l'époque gréco-romaine', in Nenna (n. 12), 97–112; Verità (n. 20); Silvestri *et al.* (n. 20); P. Mirti, A. Lepora and L. Saguì, 'Scientific analysis of seventh-century glass fragments from the Crypta Balbi in Rome', *Archaeometry* 42/2 (2000), 359–74; P. Mirti, P. Davit, M. Gulmini and L. Saguì, 'Glass fragments from the Crypta Balbi in Rome: the composition of eighth-century fragments', *Archaeometry* 43/4 (2001), 491–502; Foster and Jackson 2009 and 2010 (n. 20).
22 M. Vandini, C. Fiori and R. Cametti, 'Classification and technology of Byzantine mosaic glass', *Annali di Chimica* 96 (2006), 587–99.
23 C. Fiori, M. Vandini and V. Mazzotti, *I colori del vetro antico. Il vetro musivo bizantino*, Padua, 2004; Vandini *et al.* (n. 22).
24 J. Henderson, *The Science and Archaeology of Materials*, London, 2000, 32, 36; M. Tite, T. Pradell and A.J. Shortland, 'Discovery, production and use of tin-based opacifiers in glasses, enamels and glazes from the Late Iron Age onwards: a reassessment', *Archaeometry* 50 (2008), 67–84; W.E.S. Turner and H.P. Rooksby, 'A study of opalising agents in ancient opal glasses throughout three thousand four hundred years', *Glastechnische Berichte* 32K (1959), VII, 17–28; M. Uboldi and M. Verità, 'Scientific analyses of glasses from late antique and early medieval archaeological sites in Northern Italy', *Journal of Glass Studies* 45 (2003), 115–37; C. Fiori *et al.* (n. 23).
25 P. Marson, *Glass and Glass Manufacture*, London, 1919, 29.
26 C.P. Stapleton, I.C. Freestone and G.E. Bowman, 'Composition and origin of early mediaeval opaque red enamel from Britain and Ireland', *Journal of Archaeological Science* 26 (1999), 913–22; I. C. Freestone, C.P. Stapleton and V. Rigby, 'The production of red glass and enamel in the Late Iron Age, Roman and Byzantine periods', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003, 142–54; I.C. Freestone, H. Bronk and C.P. Stapleton, 'Why are red glasses different?', oral communication at *The Composition of Byzantine Glass Mosaic Tesserae. Leverhulme International Network*, workshop 8–13 June 2008, Venice and Ravenna; D.J. Barber, I.C. Freestone and K. Moulding, 'Ancient copper red glasses: investigation and analysis by micro-beam techniques', in A.J. Shortland, I.C. Freestone and T. Rehren (eds), *From Mine to Microscope: Advances in the Study of Ancient Technology*, Oxford, 2009, 115–27.
27 Fiori *et al.* (n. 23).
28 Tite *et al.* (n. 24).

Chapter 5
The Observation and Conservation of Mosaics in Ravenna in the 5th and 6th Centuries

Cetty Muscolino

Introduction

Before getting to the core of the argument I would like to emphasize that works of art should be approached with sensitivity and care. We are faced with images that express ideologies, dreams and hopes, and are in the presence of ideas that have been manifested in materials. It therefore follows that the more that the material is altered or changed, the more it corrupts the purity of the original message. The uniqueness of each work of art and its polysemy, however, require that somehow we take it apart. Research is necessarily segmented, but this in turn means that we lose sight of the totality of the work of art, its heart.

Often in iconological and iconographic studies, or in history or economics, the material of a work of art is ignored. Conversely, studies which prioritize an investigation of the constituent materials lose sight of the meaning and purpose of the work, and this can lead to erroneous interpretations, or to the underevaluation of important aspects. Hence the need for a convergence of observations; a convergence which is no doubt necessary with respect to any work, but even more so for mosaics which are so prominently segmented.

Specialized studies have recently made considerable progress in understanding a work of art by 'placing it on the operating table'. The work of art is examined as a corpse on which an autopsy, so to speak, is carried out. However, the task of the scholar here is to perceive the work in its original vitality and richness. Although approaches to art, from architecture to individual works, are varied and offer methods to deal with parts of the whole, we can only enjoy works of art when their units are reassembled. It is therefore necessary to go beyond such specialist methods in order to recover the original idea and the initial inspiration for the work of art.

All restoration sites have a variety of problems, but there is no doubt that decorative mosaics require special attention. In my view, studies conducted over the past 20 years on mosaics, considered in their completeness from mortar to mosaic tesserae, have not provided an entirely satisfactory picture. Only the inattentive and inexperienced could possibly consider a mosaic with marble, stone, ceramic and glass tesserae to be a homogenous work. In addition material considerations must be given to gold and silver foil glass tesserae, an area of study that still offers great opportunities

Plate 1 View of the dome, Neonian Baptistery, Ravenna

Plate 2 Detail of vegetal gazebo, vault, Neonian Baptistery, Ravenna

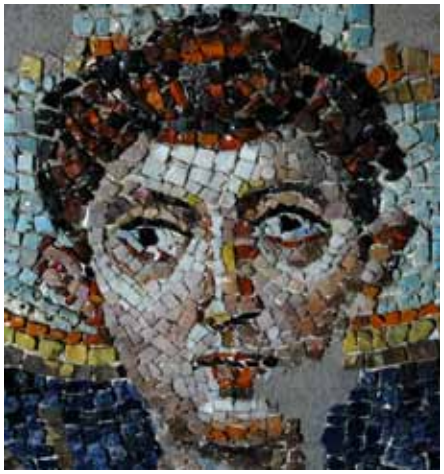


Plate 3 Detail of St Simon the Canaanite, vault, Neonian Baptistery, Ravenna

Plate 4 Detail of St Bartholomew, vault, Neonian Baptistery, Ravenna

for research, or to various types of glasses, which suffer from a range of diseases and are in need of suitable treatment. Likewise, surveys carried out to discriminate between the original surface and substrate parts and later changes are extremely laborious.

A mosaic comes to us transformed by additions and manipulations of anything from a whole area to a single tessera and requires a deep understanding that can only come from direct experience. Few of the mostly iconographic and historical studies written to date take the technique developed by Giuseppe Gerola into consideration; a publication, that for the mosaics of Ravenna, remains a fundamental point of reference.[1]

Mosaics, created to complement, enhance and decorate architecture, both on floors and walls, are affected by everything that happens to the building. But beyond this dependency it retains its own intrinsic and genetic complexity, due to its composite formation. These factors have not always been properly evaluated or understood in their entirety and that has led to unorthodox choices in terms of conservation. I must point out that when speaking about a mosaic, I not only include the visible mosaic surface, that is the tesserae and the mortar that sometimes seeps through the cracks, but also the underlying layers of mortar that affect the surface. This basic complexity, the diversity and co-existence of materials, complicates all work undertaken on a mosaic, from diagnosis to cataloguing, from study to conservation.

Research conducted on how mosaics were created in recent decades has resulted in a considerable increase in information, but when close to the mosaics you sometimes have the awkward feeling that research is still at the beginning. This is because there are still more questions than answers.

An attitude of humility might be a good methodological approach as it is the complete opposite to pride and arrogance, characteristics which trust that science or rather a 'more scientific' attitude will save us from ignorance by providing a clear answer. It makes sense to take stock of ourselves on the path of knowledge, and recognize, where possible, the positive steps already taken and to be prepared to change direction when needed.

During the last 20 years, continuing on the path begun by his first director of the Soprintendenza per i Beni Architettonici e Paesaggistici of Ravenna, Corrado Ricci has progressively refined the methodological approach of restoring mosaics and thanks to a tenacity and unparalleled consistency, he has achieved nothing short of excellent results. A great impetus and significant contributions in this direction have been provided by the Scuola per il Restauro del Mosaico della Soprintendenza of Ravenna, active since the 1980s and part of the Opificio delle Pietre Dure in Florence. Working groups with specific and different skills have in combination allowed a deeper understanding of the materials which has resulted in a catalogue of mosaic tesserae and the mortars underneath, as well as a database of Byzantine glasses.

The combination of regular visits to restoration sites and continuous team work, whenever possible, have facilitated the disentanglement of the maze of tesserae. In addition scholarly studies have progressed, supported by disciplines such as physics, mineralogy, and the electronic cataloguing of data recorded on site. Yet, I am deeply convinced that it is essential for time to be spent in front of a mosaic, that all conclusions should be well backed up and for supporting material evidence to be reinforced with extreme clarity. Many questions are still unanswered. For example, where did the mosaic glass originate from and at what stage of processing might it have reached Ravenna where the superb mosaics that make the city a unique gem in the world were created in the 5th and 6th centuries. How were the materials prepared and organized during the construction period? Were the mosaic tesserae cut on the ground or directly on the scaffolding?

Careful inspection of the mosaic surfaces suggest that most of the tesserae of regular size and shape, the typical cube, were cut on the ground, while adjustment of particular shapes, to be used in, for example, the faces of the main figures, was carried out on the scaffolding.

Every site that I have been privileged and fortunate to work at, such as in my role as director of work/conservation at San Vitale, Sant'Apollinare Nuovo, Sant'Apollinare in Classe, the Neonian Baptistery (**Pls 1–4**) and the Mausoleum of Galla Placidia, has opened up new vistas and new perspectives. Hours, months and years have been spent on

top row:
Plate 5 Detail of a floral element, western lunette, Mausoleum of Galla Placidia, Ravenna

Plate 6 Detail of the western intrados, Mausoleum of Galla Placidia, Ravenna

bottom row:
Plate 7 Detail of sultan's chicken, vault, Neonian Baptistery, Ravenna

Plate 8 Detail of tesserae of natural glass, Neonian Baptistery, Ravenna

the scaffolding in order to observe and investigate the mosaics with the aim of deciphering and understanding what lies beneath the tesserae. Hidden by veils of dense dust, I have had to determine which was the more serious disease and which parts were in most imminent danger.

There have been special occasions when touching the tesserae has led to a feeling of how the fingers and fingertips of mosaic craftsmen worked with the soft mortar. I have often admired the beautiful materials, combined with skill and surprising chromatic sensitivity: glass of many colours, tesserae cut in regular and consistent sizes for the base and others shaped ad hoc as if they were brushstrokes of glass. Each of the monuments is characterized by the presence of particular materials, specific solutions of distribution and their own colour palette. Thus the intense blues in Galla Placidia (**Pls 5–6**) are of a unique variety, while in San Vitale there is a careful distribution of materials according to the importance of the figures:[2] rare white glass rods in circular cross sections have been used in the panel of the court of Empress Theodora, but they are completely absent in the opposite panel of Emperor Justinian. Likewise in the Neonian Baptistery, there is a widespread and unusual presence of unworked raw glass (**Pls 7–8**). These are some of the many clues that could shed light on the organization of the work sites, changes in production techniques and in execution, and thus provide answers to many, still unanswered, questions.

The church of San Vitale

San Vitale is certainly impressive in the clever distribution of mosaic materials used to emphasize the iconographic programme which is divided into a sort of faint diaphragm that discriminates between the mosaics in the presbytery and those in the apse. A golden line seems to run from the medallion of Christ Pantocrator, placed at the top of the presbytery arch, across the vault towards the Lamb of God in the roundel with stars and beyond to the Cross at the centre of the apse arch through the white alpha monogram between the angels (**Pls 9–11**). From there the line of light enters into the arch, pausing on the cross in the mother of pearl halo, before reaching the majestic figure of Christ Cosmokrator (**Pl. 12**), who is seated on a blue background. In the great presbytery arch, with the figure of Christ, which was partly redone after half of it fell down during an

Plate 9 Detail of the intrados of the apsidal arch, San Vitale, Ravenna

Plate 10 Detail of jay, intrados of apsidal arch, San Vitale, Ravenna

Plate 11 Detail of Greek partridge, intrados of apsidal arch, San Vitale, Ravenna

Plate 12 Detail of the Enthroned Christ, apse, San Vitale, Ravenna

earthquake in Late Antiquity, is a gallery of apostles set in medallions. Note the different physiognomic characteristics, from the strong pride and determination of Peter in his devilish eyebrows (**Pl. 13**), to the flashing eyes of the dishevelled Andrew and the velvet-like softness of John (**Pl. 14**), all captured by the mosaic craftsmen of refined sensitivity and psychological insight. Stopping to explore more thoroughly, one perceives the dynamic 'play' of tesserae and fragments and the speed of pattern installations that appear like brushstrokes materialized in glass. One passes from calm and tranquil areas to scenes with a prevalence of swirling lines; from facial complexions of delicate colours to the most extreme bright shades of orange glass used to highlight anatomic depth.

Plate 13 Detail of St Peter, presbytery arch, San Vitale, Ravenna

Meticulous inspection of all the decoration during a decade of restoration and maintenance has enabled progress in the knowledge of construction techniques and the identification of the various phases of the mosaic cycle in the basilica. It seems that the decoration of the apse and the imperial panels preceded the decoration of the presbytery and the jewel-like pattern that frames it. The decoration of the presbytery is, in turn, divided into two large sections of work: the first includes the area from the vault, the side walls down to and including the figures of the evangelists, the east wall down to the bottom frame of the three windows, the triumphal arch down to and including the representations of Jerusalem and Bethlehem, and the presbytery arch down to the medallions of James of Alexandria on the right and Matthew on the left; the second section includes all mosaics below the first.[3] The range of colours of the glass used is very wide: purple, grey, green, red, pink, ochre, yellow, navy blue, azure, light blue, green and orange (**Pl. 15**), and each colour ranges from three to eight shades. The decoration of the apse adds yet more colours to this great variety of glasses such as grey-violet, yellow-brown-green and a particular

Plate 14 Detail of St John, presbytery arch, San Vitale, Ravenna

Plate 15 Detail of clothing from the procession of Theodora, apse, San Vitale, Ravenna

Plate 16 Lady-in-waiting to the right of Theodora, detail from the procession of Theodora, apse, San Vitale, Ravenna

Plate 17 Detail of Theodora's jewellery, apse, San Vitale, Ravenna

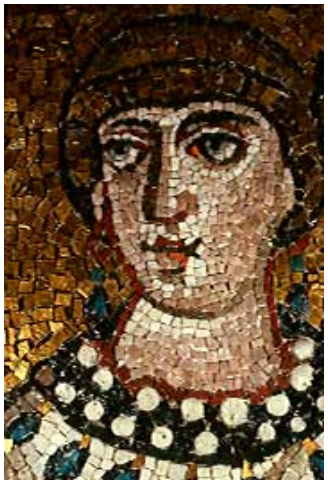


Plate 18 Lady-in-waiting, detail from the procession of Theodora, apse, San Vitale, Ravenna

Plate 19 Detail of clouds, apsidal basin, San Vitale, Ravenna

opaque yellow in the necklace of the female figure to the right of Theodora (**Pl. 16**), which is entirely absent elsewhere. Note that the largest mosaic tesserae on the entire surface is the exceptionally large orange tessera (5 x 4cm) used in Justinian's *fibula*.

The apse is also embellished with circular pieces of glass, white in colour, obtained by cutting glass rods between 8–18mm² thick. These are also present sporadically in the presbytery where they are used mainly in the jewellery of the empress and the ladies of the court. Mother of pearl, used also in circular shapes of 12–20mm² in the apse, was not used in the presbytery (**Pls 17–18**). The selection of materials in the apse is qualitatively brighter and represents a precise and determined choice: in this area of excellence there is no room for the chiaroscuro shade of stone materials. The language of light triumphs in the areas imbued with the highest spiritual and temporal power, that is, areas at the top levels of hierarchy. There are at least two types of gold foil tesserae used according to precise criteria. The 'warmest' gold foil tesserae (**Pl. 19**), with an amber-coloured support glass, is reserved for the halos of the most significant figures. This type of tessera is very bright due to the compact and well-protected top layer of very transparent, thin glass (cartellina). The gold tesserae, which appear more 'cold', have a support of green glass, a more fragile metal foil and a less transparent cartellina, are totally absent in the apse.

By comparison with the mosaics in the presbytery, the apse mosaics contain exclusive use of gold, silver, glass and mother of pearl tesserae, except for some of the figures in the panel of Emperor Justinian, which were constructed at a later date before work at the site came to an end. These include, for example, the figure of Bishop Maximian, who consecrated the basilica and whose representation probably replaced one of his predecessors.

Sant'Apollinare in Classe

Recent discoveries in mosaics, already well-investigated in the past, such as the identification of areas of 6th-century mosaics in the upper register of the triumphal arch of Sant'Apollinare in Classe (**Pl. 20**) generally attributed to the 7th or 9th century, make us understand how much there is yet to be explored.[4] It was only thanks to an extremely accurate survey conducted on the mosaic and, where possible, the mortar background, that it became possible to discriminate between different areas of mosaics and to attribute them to different times of execution. While all the studies conducted up to this point considered the whole top register of the arch as a uniform work executed sometime after the 6th century, it is now possible to define areas of intervention and to attribute a good deal of the decoration to mosaic workers active in the 6th century: I refer in particular to the evangelist symbols which, in many ways, connect strongly to the mosaic decoration of the apse of San Vitale. It is precisely from the analysis of different aspects of the

Plate 20 View of the apse, Sant'Apollinare in Classe, Ravenna

Plate 21 Detail of Christ, apsidal arch, Sant'Apollinare in Classe, Ravenna

Plate 22 Symbol of the evangelist Mark, apsidal arch, Sant'Apollinare in Classe, Ravenna

mosaic that it is possible to draw a definite line between the symbolic representations of the evangelists and the central clipeus of Christ's blessing surrounded by colourful clouds (**Pl. 21**), which was probably made in the 11th century.

The analogy between the use of different materials organized in different styles which concur with the results of my numerous inspections since 1985 of the Ravenna mosaics amounts to a privileged guide that allows the precise tracking of this map. It is undeniable that the decoration on the triumphal arch ranges from a very accurate execution conceived with great skill to a more generic execution which, in some details, could even be called sloppy. The first stage of formal rigour and careful selection of the finest materials is replaced by a glaring lack of material. How do we explain, for example, the change from the use of the brightest glass in the earlier phases to the wide use of limestone in the clipeus of Christ blessing, the principal figure of the decoration? And why does the border of ornamental jewellery of the clipeus contain all kinds of available material? Was it a question of reusing any material that was available?

Certainly, from the perspective of a viewer looking up at these mosaics in the 21st century, one could argue that to focus on such details is completely irrelevant since the mosaics are located far from the observer both in time and space. However, based on my long experience of working on wall mosaics of the 5th and 6th centuries at individual sites, I am convinced that in general even the most remote parts, including those not visible from below, have been executed with precision and accuracy, without leaving anything to chance, let alone disorder.

When, however, there is a break and interruption to the elegant and harmonious beauty of a mosaic, this could be the result of obstacles or 'accidents', alterations, repairs necessitated by the effects of time, or of fallen areas of tesserae caused by seismic and other events. Often, previous restorations of mosaics were in the form of patches. Most of the time those who restored the mosaics were guided by the need to fill a gap and did not aim to create a harmonious fit with the original mosaics, which would have required more time, knowledge and understanding of restorative work. Furthermore, they would have needed to use new tesserae in ways determined by the original design. Consequently, the top areas of Christ and the Apostles Peter and Paul in the arch between the nave and the presbytery in San Vitale are made exclusively of glass tesserae. Gradually, further down the arch, stone materials take over. Similarly, the material for the baskets with fruits and birds at the base of the lunettes in the presbytery have been used in a very free and relaxed manner and includes fragments that are not precisely cut, which had perhaps at first been rejected, but then used because of the need to finish the work as soon as possible.

Returning to Sant'Apollinare in Classe, during work on the mosaics, the underlying layers were also inspected. The representations of the eagle, angel, lion (**Pl. 22**) and ox (**Pl. 23**), the iconographic symbols of the evangelists, represent the formal regularity and rigour in mosaics and the quality of the materials used in the 6th century. The central area of the register with the clipeus of Christ between the angel of Matthew the Evangelist and the lion of Mark the Evangelist, is characterized by a fragmented approach, simplified design, tesserae of reduced size and quite visible interstices. This coexistence of two different stylistic and chronological interventions derives from the stratigraphic relationships between the mortars. Fortunately, despite the fact that the whole 6th-century mosaic was restored in 1949–50 when the original plaster was replaced with cement mortar, a small area of precious mosaic, by the figure of Matthew the Evangelist, was left with the original layer of mortar.

Plate 23 Symbol of the evangelist Luke, apsidal arch, Sant'Apollinare in Classe, Ravenna

Plate 24 Detail of clouds, apsidal arch, Sant'Apollinare in Classe, Ravenna

From a comparison between this mortar and that of the mosaic made probably in the 9th or 11th century, the following can be observed: the mortars are of different colours and the stratigraphic relationship between the two suggests a clear overlap of the old restoration on top of the bedding mortar of the original mosaic from the 6th century. It has also been noted that the gold foil tesserae were inserted into the mortar in a way similar to that used for the Archangels Michael and Gabriel in the same church and in some of the surrounding areas of the figure of the Emperor Justinian in San Vitale, all of which were intentionally set slightly above the other tesserae. This method is clearly visible in the halos of the eagle, the ox and in some of the gold foil tesserae in the swirls of clouds where they create the effect of touches of light. The gold foil tesserae used in the triumphal arch are of two types: one has a transparent support of a greenish colour, the other a transparent support of amber-coloured glass with a thin layer of red below; the latter is similar to most of the gold foil tesserae in the basilica of San Vitale. In these latter tesserae, which are larger than those with the green support, the gold foil is more compact thus ensuring a greater ability to refract light.

The two different types of gold are mixed only in the gold swirls of the clouds, while the only remaining original gold halo, belonging to the ox of the evangelist Luke, is made solely of gold foil glass with the amber support. Even in the modern work on San Vitale, gold foil tesserae are always distributed and used with great knowledge, and never mixed in any of the most iconographically important figures. While different types of gold co-exist in the various haloes of the evangelists and prophets in the presbytery (although usually with the precaution of a warmer colour in the first two rows of tesserae close to the face, followed by the other type of gold), the prophet Moses, and the three angels visiting Abraham, all have halos with gold of the highest quality. For the most part, this method is rigorously adhered to in the figures in the apse.

In summary, the upper mosaic sections in the apse arch in Sant'Apollinare in Classe attributable to Byzantine craftsmen demonstrate a constant balance between the form of the tesserae and the method used, a careful choice of colours and a rigorous use of materials. This can be clearly seen by close observation of the multi-coloured clouds that stand out against the blue background: perfect and ethereal in the 6th century, coarse and simplified in the following (**Pl. 24**).

Sant'Apollinare Nuovo

The most challenging work for the restoration team was undoubtedly that of Sant'Apollinare Nuovo, built by the Emperor Theodoric (AD 493–526). This was almost a test case, because the apparent homogeneity of the mosaic decoration belies an extreme complexity caused by the eradication of those elements relating to the 'heretical' Arian faith, and the insertion of the processions of male and female martyrs. The changes in dedication and worship, in the iconographic programmes and of craftsmen required a variety of approaches and skills. The work carried out by the school led to an initial investigation of an approximately 10m long stretch on the south wall and subsequently another 10m on the north wall (**Pl. 25**). The work was divided into several phases, including archival and library research, photographic surveys and subsequent drawings for the preparation of thematic maps, analysis of the mosaic surface and restoration work following an established methodology.

The interaction between the various scholarly disciplines (petrology/mineralogy, colour theory, art techniques, restoration techniques, iconology and iconography and so forth) was very important and the interpretation of data collected in order to understand the site took both critical historical information, as well as on-site observations, into account. The creation of mosaic drawings, a pictorial transcription of the mosaic patterns, which was a tradition mosaic conservators began in the early 20th century, formed part of the documentation. In addition to the drawings made according to the traditional technique by outlining the individual tesserae, we undertook a new study which did not look at the tesserae individually, but homogeneous colour fields in order to see colour, not in isolation, but in relation to other colours. This colour-form analysis has enabled a deeper insight into the execution of mosaics and a better understanding of the rules that applied in the construction of mosaic images. The complexity of the investigation and the large amounts of recordable data required a rigorous methodology and a flexible method of recording that could allow for the inclusion of new data when it appeared. The

Plate 25 General view of the north wall of Sant'Apollinare Nuovo, Ravenna

Plate 26 Detail of the separation of the sheep and goats, dating to the period of Theodoric, north wall, upper register, Sant'Apollinare Nuovo, Ravenna

Plate 27 Detail of the healing of the possessed man, dating to the period of Theodoric, north wall, upper register, Sant'Apollinare Nuovo, Ravenna

research was based on an evaluation of the mosaic surface and the mortars below, of the stratigraphic relationships between the various interventions and the systematic comparison of the documentary sources. With the assistance of technicians from the Opificio delle Pietre Dure in Florence, the specific aim was to detect manipulations carried out during previous restorations from the 19th century to those done following the damage caused by the First World War (1916) and the interventions by the Gruppo Mosaicisti of Ravenna after the Second World War. In this way it was possible to revise the Historical Tables of Corrado Ricci.[5]

After having restored the upper registers from the reign of Theodoric, with scenes depicting Christ's miracles (**Pls 26–7**) and the figures of the prophets, the last phase of the intervention looked at the final 8 of the 22 female martyrs (virgins) on the north wall, exiting the city of Classe. No more dramatic characterization of philosopher-prophets from the reign of Theodoric, forced and intensely expressive, but a fabulous and elegant parade, whose modulated and rhythmic repetition was in the past considered to be the result of technical skill. Hippolyte Taine (1828–93) wrote in *Voyage en Italie*, 'Nulle physionomie; souvant les traits du visage sont aussi barbares que les dessins d'un enfant qui s'essaye. Le col est roid, les mains sont en bois, les plis de la drapperie sont mécaniques... En effet, il n'y a pas de ces personnages qui ne soit un idiot hébété, aplati, malade.'[6]

In fact, the row of female martyrs (**Pls 28–9**), moving slowly between palm trees and flowers, dazzles us with the amazing opulence of their robes woven with gold and mother of pearl, which are even more vibrant following the removal of dirt and dust. The gentle glow of the faces, defined by the outlines rather than by chiaroscuro effects, dominates the centre of the large golden halos. The slight physical and expressive variations require careful attention and a more intimate approach in order to catch the subdued undertones and subtle differences. In relation to the large surface of the mosaic decoration, the restoration work carried out to date represents only a small part, but it is the right foundation and offers a guide for future work. Mineralogical and petrographic analyses were carried out in order to identify the stone materials. Gold and silver foil tesserae from the two different phases of construction were also investigated. There is a lack of uniformity in the same phase of the mosaics from Theodoric's reign, for example in the middle register with the figures of the prophets, who are more likely martyrs of the Arian faith, rather than Old Testament prophets (**Pls 30–2**). The face of the second

Plate 28 Detail of St Eugenia, dating to the period of Bishop Agnellus, procession of the Virgins, north wall, Sant'Apollinare Nuovo, Ravenna

Plate 29 Detail of St Emerenziana, period of Bishop Agnellus, procession of the Virgins, north wall, Sant'Apollinare Nuovo, Ravenna

Plate 30 Detail of a prophet, dating to the period of Theodoric, north wall, second register, Sant'Apollinare Nuovo, Ravenna

Plate 31 Detail of a prophet, dating to the period of Theodoric, north wall, second register, Sant'Apollinare Nuovo, Ravenna

Plate 32 Detail of a prophet, dating to the period of Theodoric, south wall, second register, Sant'Apollinare Nuovo, Ravenna

prophet from the west on the south wall has been constructed entirely with glass tesserae placed in regular order with respect to the muscular structure of the face. The colours go from dark to light and include mainly pinks, whites and purples. There are only four orange tesserae, three by the left nostril and one by the corner of the mouth; light glides over the surface of the brown face framed by long hair and white beard. The solemn and authoritative expression recalls representations of classical philosophers. In comparison the face of the prophet directly opposite on the north wall (**Pl. 31**) has a stronger colour contrast with an abundant use of orange glass tesserae to highlight his cheekbones, mouth and nose. However, in addition to this colour contrast there is also the question of materials: in addition to glass, pink limestone tesserae have also been used which interact differently with light than the adjacent glass, and contribute to making the face appear very artificial.

The end result is a very rough mosaic texture with tesserae cut in varied and irregular shapes. In-depth research of the physiognomic features gives the impression that one is faced with what was a real person; in other words, it was a portrait of someone in particular. In general, subject to confirmation by examination of the entire surface, it seems that while the mosaics on the south wall from Theodoric's reign are made entirely of glass mosaics, the materials on the opposite north wall are rather mixed. Certainly such an important matter cannot be attributed solely to the presence of two teams of mosaicists, perhaps working at the same time, but it could be connected to more subtle theological motives and how sunlight interacts with the two walls at certain times of the day and of the year. The delicate complexion of the female martyrs in the register below has rose limestone tesserae at the outer edge and white glass at the centre. The eyes, whose pupils are made up of single dark purple tesserae, are outlined by rows of purple, clear and white glass tesserae, resulting in a bewildered stare and sometimes a slight wink. The slight variations in colour tones barely allude to the plasticity of the faces that are almost defined more by the contour lines of the design than by chiaroscuro effects. On the heads, tilted slightly forward, precious gold diadems with glass jewels that alternate in orange and green, adorn their hair made of dark purple glass, gold, terracotta and yellow glass. The whiteness of the faces, placed against halos made of large pieces of gold foil tesserae with an amber-coloured support, is further enhanced by the short veil in white and grey marble.

These figures introduce new materials not present in the upper registers and the *Civitas Classis* section from the reign of Theoderic: mother of pearl, cut into circular discs used to adorn the rich garments, and terracotta tesserae juxtaposed with gold tesserae according to a pattern used frequently in the presbytery mosaic in the church of San Vitale. In addition, there is a new kind of compact gold foil with a thin cartellina and an amber-coloured support similar to the gold tesserae used widely in San Vitale. The mosaic texture of the background surrounding the figures of the female martyrs is very sparse making the interstice mortar (**Pl. 33**) with traces of original colours highly visible. In some places the tesserae are placed so far apart that there seems to be tesserae missing. However, this is the original setting in which colour effect was obtained both by the coloured tesserae and the bedding mortar, an effect preserved despite the aggressive washing of the surface that was carried out during later interventions. The two different phases of construction are characterized by two distinct ways of making mosaics: while the figures from the reign of Theodoric have a softness to the draperies that gives an impression of the body underneath and a physiognomy that shows the influence of Roman Hellenistic portraits, the draperies of the male martyrs constructed under the episcopate of Agnellus have no softness and nuances in colour and represent the typical two-dimensionality of Byzantine art.

The composition and use of gold foil tesserae changes radically when Agnellus takes over: the small tesserae with a greenish glass support in the earlier two upper registers are

Plate 33 Detail of the procession of the Virgins, north wall, Sant'Apollinare Nuovo, Ravenna

Plate 34 Detail of a deer drinking from a spring, western lunette, Mausoleum of Galla Placidia, Ravenna

Plate 35 Detail of the spring, western lunette, Mausoleum of Galla Placidia, Ravenna

replaced by gold foil tesserae with an amber-coloured glass support. However, this change can be observed already in the *Civitas Classis* section, in contrast to the opposite *Palatium* area[7] that is securely dateable to the reign of Theodoric, which has a mixture of gold foil tesserae with either green or amber support.[8]

The study of construction techniques, the recording of materials, an overview of the state of conservation and restoration have allowed insights into the history and art history of the mosaics and represent new stages in our knowledge of the work. It is a large undertaking that can only be done in small steps and it is important to document the process in a clear and understandable way for those who will continue the future work. These and many others are some of the considerations concerning the mosaics in Ravenna. However, beyond surveys and field studies, there is always the great emotional response that these surfaces in dialogue with the architecture awake in us. It has become clear to me after close observation of the mosaics that their strength is partly determined by the skill, precision and the exquisite sensitivity of those who created them. All the magic that attracts us emerges from all the expert solutions adopted by the craftsmen of the mosaics.

Mausoleum of Galla Placidia

During the work on the west (**Pls 34–5**) lunette in Galla Placidia, which depicts two deer drinking from a spring, I had the opportunity to observe colour combinations of glass tesserae and colour shades that have not been previously noticed at other sites in Ravenna. In addition to having noted the usual difference between colour choices in different mosaic areas it is, for example, evident that the opposite symmetrical lunette (**Pls 36–8**) is much richer in gold foil tesserae as well as iconographic details. Even within the same lunette there is diversity of colours and in the manner of execution between the two deer. For example, the coat of the deer on the right is made from delicate shades ranging from light beige to light pink, from grey-blue to grey to blue-grey. In addition, a light brown has been used for the eyes and antlers and a dark purple tesserae for the pupil of the eye, which in the other deer is made of dark green glass. Furthermore, the deer contains numerous pieces of yellow-green glass and the tesserae of the belly have been set almost like a comb. The acanthus foliage has been achieved to great effect with the use of blue-green, green, gold and green-yellow glass creating subtleties from yellow to gold to green to green-blue. Note in particular the strength of the transparent dark green in the acanthus leaf shown from the side. This is just one example, based on minimal observation, which is part of the creation of the whole effect that the viewer can enjoy. I would therefore like to conclude with the following, because science, although necessary, does not exclude poetical contemplations.

As soon as one enters the mausoleum you find yourself in a cozy night-like atmosphere where one seems to hear gushing water, like a soft and light rustling that animates and pervades the shade. There is a strong feeling of excitement and pulsating life. It is something that goes beyond a planned theological programme or political ideology. It is one of those rare cases, where as if by magic, a work of art makes us feel that it has been created from an unknown superior inspiration and is a reflection of ideas that go beyond the awareness of the historical time in which it was created and is therefore part of something bigger. Its values are transcendent and it represents an absolute perception of life and total denial of death that can be felt in the silence of contemplation. Its story is understandable if one tunes into its wavelength and it is not represented only as symbolic, but part of reality; man is perceived as part of the universe and feels with confidence and certainty that he belongs to the whole. In the marvellous chapel of Galla

Plate 36 Detail of a deer drinking from a spring, eastern lunette, Mausoleum of Galla Placidia, Ravenna

Plate 37 Detail of deer's head, eastern lunette, Mausoleum of Galla Placidia, Ravenna

Plate 38 Detail of the spring, eastern lunette, Mausoleum of Galla Placidia, Ravenna

Placidia there is such uniqueness that goes beyond all the stylistic, iconological and material values which are executed to such a high degree of perfection. Death and life are present as a continuous flow, without breaks and violence, pain or tears. With a reassuring sense of lightness in the stars that swirl eternally above, we can feel the breath of love and all beings that have gone before us and those who will follow. There are places which have a special concentrated energy and vitality that for centuries continues to emanate and pulsate. The Mausoleum of Galla Placidia is one of those places where complex doctrinal disputes and grand designs have lost their grave and heavy footing, where they have magically become poetry and soar and flutter like sublime notes. They shine almost like philosophers' stones in the mud and speak to the hearts of children and our souls, perhaps because the materials have been transformed and built by human construction according to rules that are superior to nature. These works of art stretch beyond time and borders set up by man.

There have been many discoveries in recent years and there are many to come if work persists with passion and consistency, with the consideration that the human eye cannot be replaced by even the most sophisticated and expensive device. We are continuously opening new avenues of investigation and putting forward new hypotheses: we are just at the beginning of a wonderful adventure.

Notes

1 G. Gerola, *La tecnica dei restauri ai mosaici di Ravenna* (Atti e Memorie della Regia Deputazione di Storia Patria per le Romagne, quarta serie, VII), Bologna, 1917, 102–94.

2 L. Alberti and C. Muscolino, 'The conservation of the mosaics of San Vitale in Ravenna, Italy 1989–1999, construction technique and treatment methodology', in *Proceedings of the VIIIth Conference of the International Committee for the Conservation of Mosaics – ICCM* (confer. proc., Thessaloniki, 2002), Thessaloniki, 2005, 169–80; L. Alberti and A. Tomeucci, 'Intervento di restauro sui mosaici dell'arco di ingresso al presbiterio in S. Vitale a Ravenna', in C. Fiori *et al.* (eds), *Restauri ai mosaici nella basilica di S. Vitale a Ravenna. L'arco presbiteriale*, Faenza, 1990, 90–130.

3 Alberti and Muscolino (n. 2).

4 C. Muscolino, E. Carbonara and E.R. Agostinelli, *Il leone di Bisanzio a S. Apollinare in Classe, Ravenna*, Ravenna, 2008.

5 C. Ricci, *Monumenti. Tavole Storiche dei Mosaici di Ravenna*, Rome, 1930–7.

6 'No facial characteristics; features are often as crude as a child's efforts at drawing. The neck is stiff, the hands wooden, the folds of drapery mechanically executed. In fact not of these characters looks other than dumbly idiotic, flat, sick': one H. Taine, *Voyage en Italie*, Paris, 1889 (2nd edn.), 211–12.

7 The *Palatium* is the original Latin inscription.

8 E. Carbonara, C. Muscolino and C. Tedeschi, 'La luce nel mosaico: le tessere d'oro di Ravenna. Tecniche di fabbricazione e utilizzo', in *Atti del VI Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico – AISCOM, Venice 20–23 Jan 1999*, Ravenna, 2000, 709–18.

Select bibliography

Alberti, L. and Tomeucci, A. 'Intervento di restauro sui mosaici dell'arco di ingresso al presbiterio in S. Vitale a Ravenna', in C. Fiori *et al.* (eds), *Restauri ai mosaici nella basilica di S. Vitale a Ravenna. L'arco presbiteriale*, Faenza, 1990, 90–130.

Alberti, L. and Muscolino, C. 'The conservation of the mosaics of San Vitale in Ravenna, Italy 1989–1999, construction technique and treatment methodology', in *Proceedings of the VIII^h Conference of the International Committee for the Conservation of Mosaics – ICCM* (conf. proc., Thessaloniki, 2002), Thessaloniki, 2005, 169–80.

Angiolini Martinelli, P. *Aspetti della cultura figurativa paleobizantina nei mosaici di S. Apollinare Nuovo a Ravenna* (Corso di Cultura sull'arte Ravennate e Bizantina – C.A.R.B.), Ravenna, 1976, 7–20.

Carbonara, E., Muscolino, C. and Tedeschi, C. 'La luce nel mosaico: le tessere d'oro di Ravenna. Tecniche di fabbricazione e utilizzo', in *Atti del VI Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico – AISCOM, Venice 20–23 Jan 1999*, Ravenna, 2000, 709–18.

Fiori, C. and Muscolino, C. *Restauri ai mosaici nella basilica di S. Vitale a Ravenna. L'arco presbiteriale* (Istituto di Ricerche Tecnologiche per la Ceramica, C.N.R.), Faenza, 1990.

Gerola, G. *La tecnica dei restauri ai mosaici di Ravenna* (Atti e Memorie della Regia Deputazione di Storia Patria per le Romagne, quarta serie, VII), Bologna, 1917, 102–94.

Muscolino, C. 'I mosaici dell'Arcone di S. Vitale a Ravenna. Osservazioni e scelte metodologiche per un restauro', in *Mosaici a S. Vitale e altri restauri, il restauri in situ di mosaici parietali* (Atti del Convegno Nazionale sul restauro in situ di mosaici parietali, Ravenna 1–3 ottobre 1990), Ravenna, 1992, 55–62.

Muscolino, C. 'Restauri ai mosaici parietali nel presbiterio di S. Vitale', in *QdS. Quaderni di Soprintendenza* 2 (1997), 16–21.

Muscolino, C. 'I restauri musivi', in *La Basilica di S. Vitale a Ravenna. Mirabiliae Italiae*, Modena, 1997, 111–21.

Muscolino, C., Carbonara E. and Agostinelli, E.R. *Il leone di Bisanzio a S. Apollinare in Classe*, Ravenna, 2008.

Ricci, C. *Monumenti. Tavole Storiche dei Mosaici di Ravenna*, Rome, 1930–7.

Taine, H.A. *Viaggio in Italia* (ed. V. Corbello), Turin, 1866 (1st edn), 2003.

Chapter 6
A Quest for Wisdom
The 6th-century Mosaics of Hagia Sophia and Late Antique Aesthetics

Nadine Schibille

Late Antique ecclesiastical interiors carefully structure the aesthetic and spiritual experience of their visitors. In what Jaś Elsner called 'mystic viewing', the act of viewing religious art in Late Antiquity was sacred and paralleled a spiritual journey.[1] In other words, through sight (*aisthesis*) and contemplation of works of art, an initiate was able to approach and assimilate to the divine. The decoration of sacred spaces was thus instrumental in defining and constructing the viewers' aesthetic experience as well as their relationship with God.[2] The importance of sight and the anagogical capacity of visual beauty had long been recognized in the philosophical and patristic debates on the value of the material world. That these ideas were pervasive and entrenched in Byzantine society in the 6th century is evidenced, for example, in the writings of Hypatius, archbishop of Ephesus (AD 531–*c.* 538).[3] In a letter addressed to Julian, Bishop of Atramytium, Hypatius defends the use of the 'material adornment in the sanctuaries' for the 'simpler people, as they are less perfect, to learn by way of initiation about such things [the divine transcendence / intelligible beauty] by sight which is more appropriate to their natural development'.[4] Material embellishments took on a guiding role in the sense that they offer a glimpse of the divine reality that lies beyond the surface appearance.

The so-called jewelled style of Late Antiquity has to be seen in this light.[5] This style also had a functional purpose in that it made visible the splendours of the (divine) universe. Identified in literary works as well as in the visual arts, the jewelled style defines an 'aesthetic of adornment' that is characterized by variety, polychromy and sumptuous effects of light and colour contrasts.[6] The original 6th-century interior decoration of the church of Hagia Sophia in Constantinople (AD 532–7) constitutes not only one of the most striking and outstanding examples of this jewelled style, but it also exemplifies the quest for the divine and the search for wisdom (*sophia*). In particular, the mosaic decoration of Hagia Sophia that once covered the vaults and arches offered, as Robin Cormack observed, 'a highly successful visual, mesmeric effect'.[7] This sensuous (aesthetic) quality and the choice of colours and motifs are closely entwined with the Neoplatonic concept of divine wisdom and the spiritual experience of God. This paper explores the aesthetic data of the original mosaic decoration of Hagia Sophia in the widest possible sense from the perspective of the Byzantine viewer, discussing both the material properties (colours, designs and effects) and the conceptual framework within which the sacred space of Hagia Sophia would have been viewed and understood in the 6th century.[8]

Ever since its completion in AD 537, the church of Hagia Sophia has been renowned for its 'marvellous beauty'.[9] The Emperor Justinian allegedly 'disregarded all questions of expense' in conceiving and constructing his new cathedral.[10] Given these contemporary observations, the relative simplicity of the building's mosaic decoration is somewhat astounding. Judging from the remains of the 6th-century mosaics, the surfaces of the vaults and arches originally presented an expanse of geometric and floral patterns heavily interspersed with the sign of the cross.[11] This decorative scheme is in stark contrast to the elaborate narrative scenes in, for example, the Justinianic mosaics of

Plate 1 Cross vault and transverse arch of Hagia Sophia's inner narthex showing window openings to the west (left) and the eastern lunette (right) decorated with a mosaic cross

Plate 3 Large mosaic cross, embellished with alternating red and green jewels and pearls. These crosses are found throughout the mosaic decoration of the ground floor aisles

Plate 2 Westernmost bay of the southern aisle of Hagia Sophia, showing the barrel vault above the western entrance bearing three large mosaic crosses (left) and the twisted rope pattern on the transverse arch in the east (right)

the monastery of St Catherine at Sinai or in the church of San Vitale at Ravenna. The mosaics of Hagia Sophia deliberately renounced figurative representations as an essential formal principle in the attempt to create a visual unity. The intention of the decoration was to line the interior space with a luminous polychromatic membrane, the effect of which was further enhanced through the reflective quality of the mosaics that consisted almost entirely of glass tesserae.[12]

The restoration campaigns undertaken by the Byzantine Institute and Dumbarton Oaks between 1933 and 1978 have yielded significant information on the materials and techniques of the Hagia Sophia mosaics. It was established that the ornamental mosaics still *in situ* in the narthex and the ground floor aisles probably date to the 6th century.[13] The repertoire of motifs used in these original mosaics was limited to a few geometric and floral patterns and designs. Ornamental borders constitute the main organising principles and delineate the individual surface units that are generally pre-established by the architectural structure. In the narthex, these borders consist of interlocked dark blue and silver stepped patterns, framing a succession of green and gold jewels (**Pl. 1**). In the aisles, blue and silver are replaced by the colours red and gold. Here, the stepped pattern runs alongside alternating silver swastikas and quatrefoils enclosed in blue squares and circles (**Pl. 2**). These ornamental bands originate in and outline a central medallion with a jewelled Christogram in the apex of each groin vault. The barrel vaults spanning between the main piers and buttress piers in the aisles were originally decorated with large jewelled Latin crosses similar to the vaults above the western entrances of the aisles (**Pls 2**–**3**), while the soffits of the transverse arches separating these barrel vaults from the groin vault bays were adorned with zigzag patterns of twisted ropes interlaced with circular pieces of rope. Squares and roundels with stylized vegetal designs decorate the transverse arches that separate the bays of the inner narthex (**Pl. 1**). The surface units of the groin vaults that are outlined by the ornamental bands in the bays of the narthex and the aisles are decorated with geometric and floral compositions. The spandrels of the vaults in the narthex all bear identical eight-pointed silver stars with pointy egg-shapes and leaves attached to alternating ends. In the aisles, the multicoloured egg-shapes with leaves have become the dominant motif (**Pls 1**–**2**). These polychrome egg-shapes have been identified as pine cones, lotus buds or palmettes.[14] It has been proposed that the split palmette combined with an egg alludes to cherubim.[15] The main feature by far in the 6th-century mosaic decoration was the sign of the cross in different shapes and sizes, variously embellished with precious stones and pearls (**Pl. 3**). The cross is found in each lunette of the eastern wall of the inner narthex, in the window soffits of the inner narthex and in the lunettes and barrel vaults over the entrances of the aisles. The dominant colour throughout the ground floor mosaics is gold, providing the background to the patterns and borders of red, blue, silver and green tesserae.

Only a fraction of the original mosaic decoration survives at gallery level. It seems that the mosaics in the soffits of the nave arcades either date to the 6th century or instead follows 6th-century designs closely.[16] They include rinceaux scrolls on a gold background and dark blue borders with eight-pointed gold stars constructed of overlapping squares running along the edges (**Pl. 4**). Circumstantial evidence

suggests that the design of the soffits of the arches that run in parallel to the lateral arcades with spiderweb medallions and lobed diamonds on a gold ground may also have been part of the original mosaic programme (**Pl. 4**).[17] The decorative borders next to the window transennae of the apse windows, consisting of alternating St Andrew's crosses in gold and multicoloured diamonds on a dark blue background also belong to the 6th-century remains. Patches of a similar ornament have been uncovered on the western side of the bema arch. Finally, a tree and stylized palmette motif was found on the springing of the south tympanum that may also be associated with the original mosaic decoration.[18] As in the ground floor mosaics, gold was the dominant colour at gallery level, while the other colours represented are again silver, red, blue and green. According to Paul the Silentiary's 6th-century description, the centre of the main dome was adorned with an enormous mosaic cross.[19]

Taken together, there is strong material and literary evidence that the original mosaic decoration of Hagia Sophia was entirely non-figurative and consisted of only a few basic shapes in varying combinations. The mosaics draw on a long tradition of ornamental patterns from different media, including fresco painting, floor mosaics and textiles.[20] The framing of discrete compositional units, for example, is reminiscent of Roman fresco painting. The difference is that the mosaics in Hagia Sophia, in contrast to Roman frescoed *emblemata*, accentuate the surfaces and do not suggest any recession into pictorial depth.[21] The two-dimensionality of the grid pattern and the limited number of ornamental motifs are typical also of Late Antique woven textiles, and the use of an underlying warp of a darker colour observed in some fabrics could be compared to the underpaint of mosaics.[22] The desired effect is one of unity and infinity, sustained by the endlessly repeated patterns and bound together through the ornamental bands. The surfaces act as canvases for the intense colours of the mosaic designs and the play of light that interacts with and bounces off the reflective glass surface. In the 6th century, glass tesserae were evidently the material of choice.[23] Intriguingly, the colour palette was restricted to only five colours, namely gold, silver, red, blue and green, making for dramatic contrasts and juxtapositions of colours.[24]

From the limited analytical data available it transpires that the material used for the glass tesserae of Hagia Sophia is similar to that of contemporary mosaic assemblages like, for example, those from Hagios Polyeuktos at Constantinople or San Vitale in Ravenna.[25] From 22 samples analyzed by Robert Brill, 16 tesserae can be identified with some certainty as natron-type glasses.[26] The base glass composition of these samples corresponds closely to that of the so-called Roman and/or Levantine I glass groups, both of which presumably originated from large production centres on the Levantine coast.[27] Chemically, the mosaic tesserae do not differ significantly from other Late Antique glasses, showing overall typical ranges for the major and minor elements.[28] Taken together the evidence suggests that the tesserae analyzed by Brill have been part of the 6th-century decoration of Hagia Sophia and that the tesserae were chemically not exceptional, but related to other 6th-century glass and mosaic assemblages.

Plate 4 Lateral arcades of the south gallery of Hagia Sophia looking north

The mosaics of Hagia Sophia were highly unusual, however, in terms of their colours. The assemblages from Hagios Polyeuktos and San Vitale include different shades of blues and greens, amber, purple, red, turquoise and yellow in addition to gold and silver leaf tesserae.[29] Even though we do not know how mosaic workshops were organized and how they came by their materials, it is safe to conclude that the limited selection of colours in the mosaic decoration of Hagia Sophia was deliberate. It has been shown that an aesthetic preference for the brilliance and glitter of colours was characteristic in Byzantium.[30] As I have argued elsewhere, the specific colours used in Hagia Sophia (gold, silver, red, blue and green) were in fact all primary colours in the ancient sense (with the exception of green) and attest to the Late Antique aesthetics of pure and luminous colours.[31] Hence, the mosaics of Hagia Sophia do not exhibit the same chromatic diversity that has been observed in other Late Antique wall mosaics or, indeed, in the architectural painting of the Red Monastery near Sohag in Upper Egypt.[32] Instead, the beauty of the mosaic decoration of Hagia Sophia lies in the brightness (purity) of its colours and the scintillating effects created by natural and artificial light on the reflective surfaces.

The reflective properties of the mosaics were further exploited by setting the gold tesserae on many of the vertical surfaces at an angle so as to face downwards. This technique has been recorded in the lunettes on the east wall of the inner narthex, in the lunettes above the western entrance to the south aisles as well as on the vertical surfaces of the tympana. In the west windows of the inner narthex the tesserae were inclined only on the face of the north walls and not on the southern sides.[33] This implies a highly selective use of this technique that takes into account the position of the observer below and the illumination of the surfaces through the sun. Only the northern face of the window openings catches direct sunlight, making the inclination of the tesserae effective, whereas the application of the technique on the southern reveal would have no effect. It seems then that the visual impact on the viewer shaped the original mosaic decoration of Hagia Sophia decisively. The importance of the overall visual effect of the surfaces is further illustrated in the 6th-century practice of painting the

setting bed of the gold background in a deep red, which is particularly interesting in light of the yellow-ochre that was typically used in later mosaics.[34] The red underpaint often shines through and imparts a brassy tint to the gold mosaic, while the setting bed for the blue and green areas are usually painted with a dark blackish-blue pigment presumably to enhance the intensity of the colour.[35]

Despite the fact that the hue of a colour was only of secondary importance to its luminosity, there were correct or suitable colours, inasmuch as colours were believed to reveal the identity and true nature of an object or person.[36] The 6th-century historian Agathias of Myrina explicitly remarked that 'art can convey by colours the prayers of the soul'.[37] Applying the correct colour therefore meant establishing the meaning and realism of a work of art.[38] It is for this reason that in the mosaic decoration of Hagia Sophia, the colour green is almost exclusively used to render foliage and floral motifs. It is likely that the other colours used in the mosaic decoration were also considered to be the correct colours with regards to the purpose for which they were employed. That colours have a fundamental semantic and identifying quality has been substantiated in recent neurobiological studies. These found that higher cognitive functions of the brain such as memory are implicated in the perception of colour in a meaningful (i.e. non-abstract) context.[39] In other words, meaning is assigned through colours according to previous visual experiences. If the original mosaic decoration of Hagia Sophia did fulfil a function beyond the purely decorative and, if there was an underlying message to the non-figurative mosaics, then all the colours used are necessarily the correct colours in accordance with the expectations of the 6th-century Byzantine beholder.

It can be strongly argued that the purpose of Hagia Sophia was to visualize divine wisdom and, more specifically, the quest for divine wisdom in the face of human ignorance. The jewelled cross, a prevailing theme in the mosaic decoration, embellished with precious gems and pearls helped to contribute to the identity of the Great Church as the 'House of Wisdom'. Particularly prominent throughout the aisles of Hagia Sophia are large Latin crosses with flaring arms and teardrops suspended from the end of their cross arms and decorated with precious stones and pearls (**Pl. 3**).[40] Images of luxurious materials (gems, pearls and precious metals) were used as a visual vocabulary to denote divine glory and imperial excellence and power at the same time.[41] In the ecclesiastical context of Hagia Sophia, the jewelled style, in the literal sense, is above all an allusion to the heavenly Jerusalem that was built of gold and precious stones as described in the Book of Revelation and often depicted as such in Late Antique mosaics in Italy, such as at San Vitale in Ravenna or Santa Maria Maggiore in Rome.[42] The jewelled cross has thus obtained a clear eschatological character. This interpretation is sustained by numerous biblical, apocryphal and patristic sources according to which a luminous cross precedes Christ in his Second Coming.[43] The symbol of the cross, of course, offered great potential for multiple interpretations. Along with the eschatological significance, the cross in Hagia Sophia may also be associated with a cosmic dimension in that its shape exemplified the all-embracing divine power.[44] Yet, within the framework of Hagia Sophia the cross can be seen primarily to refer to the concept of divine wisdom. The theme of wisdom in connection with the sign of the cross had been developed already in Paul's First Letter to the Corinthians. By describing the 'foolishness of the cross', Paul explained that the sign of the cross proclaimed the wisdom of God inasmuch as it highlights the limitations of human comprehension.[45] The cross has become the most essential tool in shaping a Christian reality and identity, for it was the symbol of divine power and wisdom *par excellence* and has thus acquired an epistemological connotation.[46]

Paul's First Letter to the Corinthians was highly influential in subsequent patristic discussion on the nature of divine in contrast to human wisdom.[47] A strong Pauline influence is still noticeable in the 6th-century writings of Pseudo-Dionysios, when he states that 'the foolishness of God is wiser than men'.[48] It is for this reason that Pseudo-Dionysios advocated his negative theology, reasoning that because the divine transcendence escapes human knowledge the only way to express the divine is by describing it in negative terms. From these ideas follows the conclusion that the sign of the cross best exemplifies the Pseudo-Dionysian negative theology, since it embodies the divine contradictions and by extension divine wisdom. Applying these concepts to the mosaics of Hagia Sophia, it is evident that the sign of the cross, which was unquestionably the main decorative theme in the 6th century, visualizes the quest for divine wisdom. The non-figurative programme of decoration is a concession to the Pseudo-Dionysian negative theology according to which the divine paradox of immanence and transcendence cannot and should not be defined in human terms.[49]

The jewelled crosses contribute substantially to defining Hagia Sophia's sacred space and its meaning. They evoked eschatological as well as epistemological ideas, both of which are intimately entwined with light and illumination. Through analogy with the heavenly Jerusalem, the city of light built of gold and precious stones,[50] the cross equally encrusted with jewels and pearls became a *crux radiata*, a cross of light. In fact, light and luminosity were considered intrinsic qualities of gold and precious stones.[51] Just like the holy city that 'had no need of the sun, neither of the moon to shine in it: for the glory of God did lighten it',[52] so too the church of Hagia Sophia appeared to be 'not illuminated from without by the sun, but the radiance comes into being within it'.[53] At the same time, wisdom had long been associated with 'the reflection of eternal light, a spotless mirror of the working of God, and an image of his goodness'.[54] The jewelled crosses then, designed in luminous colours and highly reflective glass tesserae, are the true sources of light in an aesthetic as well as in a spiritual sense. The design of the mosaic decoration with its crosses and jewels evidently partakes in the impression of luminosity within Hagia Sophia's ecclesiastical space.[55] In combination with light, the mosaics turn the interior of Hagia Sophia into a space of symbolic significance that offers a vision of heaven. More precisely, the earthly kingdom was viewed as a (pale) reflection or image of the heavenly kingdom.[56] The material world acts as a symbol of the heavenly realm in the early Christian sense insofar as any material object

necessarily represents aspects of the divine.[57] Seen in this light, the church of Hagia Sophia is truly an image of heaven, it is divine light and divine splendour made manifest in visual language, and as such its interior serves a distinctly anagogical purpose. The endless repetition of the motif of the cross enhances the sense of divine immediacy and forcefully promotes the mysteries of the divine cosmos. The mosaic crosses in conjunction with the profusion of light visualize the metaphysical idea of divine illumination.[58]

The progress from human ignorance towards divine wisdom (or rather a weak reflection thereof) is hinted at in the differential use of the colours within the wider programme of the mosaic decoration in Hagia Sophia with an emphasis on blue and silver in the narthex and on red and gold in the aisles.[59] To return to the meaning of colour in early Byzantium, it is possible to identify a specific association between the colours employed and the phenomenon of light. As I have shown, the colours in the mosaics of Hagia Sophia represent the Byzantine ideal of pure and luminous colours. The symbolic interpretation of colours in Byzantium, however, is always context dependent.[60] Within the ecclesiastical sphere of Hagia Sophia, the colour red signifies divine light, while the colour blue is indicative of divine darkness. The two concepts are in principle interchangeable, because the divine is understood at once as absolute light and absolute darkness (inaccessible light).[61] Nonetheless, the concept of divine darkness conveys the notion of human ignorance more explicitly. This is best illustrated in the contemporary mosaic of the Transfiguration in the apse of the monastic church of St Catherine at Sinai (AD 548–65). Multiple layers of meaning have been identified to underlie the mosaic programme at Sinai.[62] What is of particular interest for the present argument is the figure of Christ, dressed in luminous white shown against a blue mandorla. The mandorla is composed of four concentric ellipses of varying shades of blue that increase in brightness as their distance from the dark blue centre increases. This portrayal basically represents a visual interpretation of the divine contradiction of being light and darkness at the same time. The ultimate source of the light that is emanating from the transfigured Christ as well as the mandorla is hidden behind the figure of Christ in the uncertainty of the dark blue core of the mandorla. This counterintuitive pictorial representation of divine light alludes to the principles of negative theology and the concept of divine darkness as inaccessible light. The mysticism of darkness is artistically expressed in the form of dark blue light that signifies the divine hiddenness and the oxymoron of divine immanence and divine transcendence.[63]

The mosaic decoration at Sinai actively guides the viewer from the material to the spiritual, culminating ultimately in a vision of God.[64] A similar spiritual ascent underlies the mosaic decoration of Hagia Sophia. The progress here is signalled through the predominantly blue patterns in the mosaic decoration of the narthex, to the more red and brassy quality of the mosaic designs in the aisles. This parallels a journey from divine darkness and human ignorance towards the (divine) light and an enlightened state.[65] The vast interior of Hagia Sophia, filled with the colour and light of the mosaic decoration, thus embodies and reflects the divine light that links the human with the divine and assists the viewer to ascend and assimilate to God.[66] The mosaics are an essential component in the aesthetic and spiritual experience of the Great Church. In fact, the aesthetic cannot be separated from the spiritual function of the mosaic decoration. It is because Hagia Sophia is a 'spectacle of marvellous beauty'[67] suffused with colour and light that its interior becomes an image of the divine and an ideal starting point in the quest for divine wisdom.

In contrast to contemporary figurative mosaic programmes that often contain narrative scenes like those at Sinai or in Ravenna, the mosaics of Hagia Sophia are exceptional due to their relative simplicity and clarity of content. Aesthetically, the desired effect is one of two-dimensional flat patterns that are spread like carpets over the surfaces and make for visual unity. There is movement everywhere; the mosaic and marble surfaces are animated through colours, light and contrasts. But in its totality the impression of the interior decoration is one of homogeneity. Spiritually, the prominence of the symbol of the cross in the mosaics conveys an aura of divine presence and divine wisdom. Early Christian writings, including biblical sources as well as philosophical texts and Christian apologia, testify to the widespread familiarity with the notion of wisdom as the conceptual framework within which the church of Hagia Sophia is situated. The schism between divine and human wisdom provided justification for the production and use of art and the embellishment of sanctuaries. The sacred space of Hagia Sophia was transcended through the agency of colour, light and precious materials (real or depicted). Its ultimate purpose was to convey the mysteries of the Christian faith, the essence of which escapes human understanding.

An anonymous inauguration hymn (*kontakion*) composed for Hagia Sophia's re-consecration in AD 562/3 explicitly refers to the Great Church as the 'sanctuary of wisdom' (*oikos 2*), here meaning the 'wisdom of faith' (*oikos 12*), which is represented in the incarnate figure of Christ.[68] Hagia Sophia is the material manifestation of the divine wisdom that the Emperor Justinian had received from God in order to build the 'divinely constructed temple' of Sophia.[69] The idea of a divinely inspired emperor is clearly reminiscent of Solomon, whom Yahweh himself had equally once bestowed with divine wisdom and who built the first temple of Jerusalem. It is tempting to see some truth reflected in a 9th-century account, according to which Justinian upon entering his newly built church of Hagia Sophia for the first time exclaimed 'O Solomon, I have surpassed thee.'[70] Evidently, it is the wisdom of Solomon that Justinian claims to have surpassed. This sentiment is echoed in a comment by the 6th-century Latin poet Corippus, who stated in reference to Hagia Sophia 'Let the description of Solomon's temple now be stilled.'[71] The church of Hagia Sophia is truly a *sanctuary of wisdom*. The jewelled style, expressed in the richness and variety of materials, colours and light effects and that characterized the original mosaic decoration was an essential visual device to engage the viewer aesthetically and spiritually. The 6th-century programme of decoration with its profusion of the cross sought through sense perception (*aisthesis*) to initiate the viewer into the mysteries of divine wisdom.

Notes

1 J. Elsner, *Art and the Roman Viewer: The Transformation of Art from the Pagan World to Christianity*, Cambridge and New York, 1995, ch. 3.

2 Ibid., 88, 97–124; E. Swift and A. Alwis, 'The role of Late Antique art in early Christian worship: a reconsideration of the iconography of the "starry sky" in the "Mausoleum" of Galla Placidia', *Papers of the British School at Rome* 78 (2010), 193–217 and 352–4.

3 The fragment is transmitted in a manuscript (*Parisinus* gr. 1115, fol. 254^{v}–255^{v}) written in 1276. F. Diekamp (ed.), *Analecta Patristica (Orientalia Christ. Analecta, 117)*, Rome, 1938, 127–9.

4 Adapted from P. J. Alexander, 'Hypatius of Ephesus: a note on image worship in the sixth century', *The Harvard Theological Review* 45 (1952), 177–84.

5 The 'jewelled style' was first defined by M. Roberts, *The Jeweled Style: Poetry and Poetics in Late Antiquity*, Ithaca, 1989; see also E.S. Bolman, 'Late Antique aesthetics, chromophobia, and the Red Monastery, Sohag, Egypt', *Eastern Christian Art* 3 (2006), 1–24; E.S. Bolman, 'Painted skins: the illusions and realities of architectural polychromy, Sinai and Egypt', in S.E.J. Gerstel and R.S. Nelson (eds), *Approaching the Holy Mountain: Art and Liturgy at St Catherine's Monastery in the Sinai*, Turnhout, 2010, 119–40; T.K. Thomas, 'The medium matters: reading the remains of a Late Antique textile', in E. Sears and T.K. Thomas (eds), *Reading Medieval Images: The Art Historian and the Object*, Ann Arbor, 2002, 38–49.

6 Ibid.

7 R. Cormack, 'The visual arts', in A. Cameron, B. Ward-Perkins, and M. Whitby (eds), *The Cambridge Ancient History, Vol. XIV, Late Antiquity: Empire and Successors, A.D. 425–600*, Cambridge, 2000, 884–913.

8 B. Jessup, 'The data of aesthetics', *Proceedings and Addresses of the American Philosophical Association* 29 (1955–6), 26–41.

9 Procopius, *Buildings*, Cambridge (MA), 1966, I.1.27; Corippus verse 280 translated in A. Cameron, *Flavius Cresconius Corippus: In laudem Iustini Augusti minoris, Libri IV*, London, 1976, 115.

10 Procopius I.1.23.

11 Many of the original mosaics have been lost over the centuries. On the basis of the sparse archaeological findings and the drawings and watercolours by Cornelius Loos (around 1710) and the Fossati brothers (1847–9), Karen Boston attempted a reconstruction of the original mosaic decoration of Hagia Sophia. See K.A. Boston, 'Imaging the logos: display and discourse in Justinian's Hagia Sophia', unpublished PhD, University of London, 1999, 175–217.

12 N. Schibille, 'Light as an aesthetic constituent in the architecture of Hagia Sophia in Constantinople', in D. Mondini and V. Ivanovici (eds), *Manipulating Light in Pre-modern Times – Proceedings of the Exploratory International Workshop, Accademia di Architettura Mendrisio 3.–4. November 2011*, Mendrisio, forthcoming.

13 E.g. R. Cormack, 'Interpreting the mosaics of S. Sophia at Istanbul', *Art History* 4 (1981), 131–48; E.J.W. Hawkins, 'Further observations on the narthex mosaic in St. Sophia at Istanbul', *Dumbarton Oaks Papers* (hereafter *DOP*) 22 (1968), 151–66; C. Mango and E.J.W. Hawkins, 'The apse mosaics of St. Sophia at Istanbul: report on work carried out in 1964', *DOP* 19 (1965), 115–51; C. Mango and E.J.W. Hawkins, 'The mosaics of St. Sophia: the Church Fathers in the north tympanum', *DOP* 26 (1972), 1–41; P.A. Underwood, 'A preliminary report on some unpublished mosaics in Hagia Sophia', *American Journal of Archaeology* 55 (1951), 367–70; P.A. Underwood, 'Notes on the work of the Byzantine Institute in Istanbul: 1954', *DOP* 9–10 (1956), 291–4; P.A. Underwood and E.J.W. Hawkins, 'The mosaics of Hagia Sophia at Istanbul: the portrait of the Emperor Alexander, a report on work done by the Byzantine Institute in 1959 and 1960', *DOP* 15 (1961), 187–217; T. Whittemore, *The Mosaics of St. Sophia at Istanbul, Preliminary Report on the First Year's Work 1931–1932: The Mosaics of the Narthex*, Oxford, 1993.

14 R. Cormack and E.J.W. Hawkins, 'The mosaics of St. Sophia at Istanbul: the rooms above the southwest vestibule and ramp', *DOP* 31 (1977), 175–251; Mango and Hawkins 1972 (n. 13); N.B. Teteriatnikov, *Mosaics of Hagia Sophia, Istanbul: The Fossati Restoration and the Work of the Byzantine Institute*, Washington DC, 1998, 15.

15 J. McKenzie, *The Architecture of Alexandria and Egypt 300 BC–AD 700*, New Haven and London, 2007, 334.

16 Underwood and Hawkins 1961 (n. 13).

17 Boston (n. 11), 175–217.

18 Mango and Hawkins 1972 (n. 13).

19 Paul the Silentiary, verses 506–8, in P. Friedländer, *Johannes von Gaza und Paulus Silentiarius: Kunstbeschreibungen justinianischer Zeit*, Leipzig and Berlin, 1912.

20 Bolman 2006 (n. 5); A. Gonosová, 'The formation and sources of Early Byzantine floral semis and floral diaper patterns re-examined', *DOP* 41 (1987), 227–37; E. Kitzinger, 'Stylistic developments in pavement mosaics in the Greek East from the age of Constantine to the age of Justinian', in *La Mosaïque Greco–Romaine*, Paris, 1965, 341–50; Mango and Hawkins 1972 (n. 13); Thomas (n. 5).

21 E. Kitzinger, *Byzantine Art in the Making: Main Lines of Stylistic Development in Mediterranean Art, 3rd–7th century*, Cambridge (Mass.), 1977, 50–1, 85; E. Kitzinger, 'Mosaic pavements in the Greek East and the question of a "Renaissance" under Justinian', in W.E. Kleinbauer (ed.), *The Art of Byzantium and the Medieval West: Selected Studies by Ernst Kitzinger*, Bloomington and London, 1976, 49–63.

22 Gonosová (n. 20); Thomas (n. 5).

23 H. Kähler, *Die Hagia Sophia*, Berlin, 1967, 47; Mango and Hawkins 1965 (n. 13); Mango and Hawkins 1972 (n. 13); Underwood and Hawkins (n. 13); Whittemore (n. 13), 11–13.

24 Underwood and Hawkins observed that colours were used very selectively and that mixed colours were avoided (Underwood and Hawkins [n. 13]).

25 For some chemical data of mosaic tesserae from Hagia Sophia see: R. H. Brill, *Chemical Analyses of Early Glasses, Vols 1 and 2*, New York, 1999, section IX; for a comparison of these data with San Vitale and Hagios Polyeuktos see: N. Schibille and J. McKenzie, 'Glass tesserae from Hagios Polyeuktos, Constantinople: their early Byzantine affiliations', in J. Bayley *et al.* (eds), *Neighbours and Successors of Rome: Traditions of Glass Production and Use in Europe and the Middle East in the Later First Millennium AD*, in press.

26 Brill (n. 25).

27 E.g. C. Fiori and M. Vandini, 'Chemical composition of glass and its raw materials: chronological and geographical development in the first millennium A.D', in M. Beretta (ed.), *When Glass Matters*, Florence, 2004, 107–50; I.C. Freestone, 'Primary glass sources in the mid first millennium AD', *Annales du 15e Congrès de l'Association Internationale pour l'Histoire du Verre. AIHV*, Corning, New York, 2003, 111–15; I. C. Freestone, Y. Gorin Rosen and M. J. Hughes, 'Primary glass from Israel and the production of glass in Late Antiquity and the Early Islamic period', in M.D. Nenna (ed.), *La Route du Verre: Ateliers primaires et secondaires du millénaire av. J.-C. au Moyen Âge*, Lyon, 2000, 65–83; I.C. Freestone, M. Ponting and M.J. Hughes, 'Origins of Byzantine glass from Maroni Petrera, Cyprus', *Archaeometry* 44 (2002), 257–72; Y. Gorin-Rosen, 'The ancient glass industry in Israel: summary of the finds and new discoveries', in Nenna ibid., 49–63; M.-D. Nenna, M. Picon and M. Vichy, 'Ateliers primaires et secondaires en Égypte à l'époque Gréco–Romaine', in Nenna ibid., 97–112; M.-D. Nenna, M. Vichy, and M. Picon, 'L'atelier de verrier de Lyon, du 1er siècle après J.–C., et l'origine des verres «Romains»', *Revue d'Archéométrie* 21 (1997), 81–7; O. Tal, R.E. Jackson-Tal, and I.C. Freestone, 'New evidence of the production of raw glass at Late Byzantine Apollonia–Arsuf (Israel)', *Journal of Glass Studies* 46 (2004), 51–66.

28 Brill (n. 25), section IX B.

29 C. Fiori, M. Vandini and V. Mazzotti, 'Colore e tecnologia degli "smalti" musivi dei riquadri di Giustiniano e Teodora nella basilica di San Vitale a Ravenna', *Ceramurgia* 33 (2003), 135–54; R.M. Harrison, *A Temple for Byzantium: The Discovery and Excavation of Anicia Juliana's Palace-Church in Istanbul*, London, 1989, 78–80; R.M. Harrison, *Excavations at Saraçhane in Istanbul, Vol. 1: The Excavations, Structures, Architectural Decoration, Small Finds, Coins, Bones, and Molluscs*, Princeton, New Jersey, 1986, 182–96, 204–06; Schibille and McKenzie (n. 25).

30 For the concept of colour in Byzantium see: L. James, 'Color and meaning in Byzantium', *Journal of Early Christian Studies* 11 (2003), 223–33; L. James, *Light and Colour in Byzantine Art*, Oxford, 1996; L. James, 'What colours were Byzantine Mosaics?', in E. Borsook, F. G. Superbi and G. Pagliarulo (eds), *Medieval Mosaics*, Milan, 2000, 35–46.

31 Schibille (n. 12).
32 Bolman 2006 (n. 5).
33 Mango and Hawkins 1972 (n. 13); Whittemore (n. 13), 11–13.
34 Mango and Hawkins 1965 (n. 13); Mango and Hawkins 1972 (n. 13); Underwood and Hawkins (n. 13).
35 Mango and Hawkins 1965 (n. 13); A. Terry and H. Maguire, *Dynamic Splendor: The Wall Mosaics in the Cathedral of Eufrasius at Poreč*, University Park (PA), 2007, 77; Underwood and Hawkins (n. 13), 187–217.
36 James 1996 (n. 30), 45–6, 62–3.
37 Agathias edited and translated in W.R. Paton, *The Greek Anthology*, Cambridge (MA), 1926, I.34.
38 J. Gage, *Colour and Culture: Practice and Meaning from Antiquity to Abstraction*, London, 1993, 47–8; James 2003 (n. 30).
39 T.C.W. Nijboer *et al*., 'Recognising the forest, but not the trees: an effect of colour on scene perception and recognition', *Consciousness and Cognition* 17 (2008), 741–52; S. Zeki and L. Marini, 'Three cortical stages of colour processing in the human brain', *Brain* 121 (1998), 1669–85.
40 As such these crosses conflate various different types like the cross *pattée*, *crux gemmata* and the *crux* radiate: E. Dinkler and E. Dinkler-von-Schubert, 'Kreuz I. Teil: K. vorikonoklastisch', in M. Restle (ed.), *Reallexikon zur Byzantinischen Kunst*, Stuttgart, 1995, 1–219.
41 D. Janes, *God and Gold in Late Antiquity*, Cambridge, 1998, esp. ch. 4.
42 Revelation 21:18–20.
43 E.g. Matthew 24:30; E. Dinkler, *Das Apsismosaik von S. Apollinare in Classe*, Cologne, 1964; Dinkler and Dinkler-von-Schubert (n. 40); F.J. Dölger, 'Beiträge zur Geschichte des Kreuzzeichens IX', *Jahrbuch für Antike und Christentum* 10 (1967), 7–29; E. Peterson, *Frühkirche, Judentum und Gnosis*, Rome, Freiburg and Vienna, 1959.
44 Dinkler and Dinkler-von-Schubert (n. 40); G. B. Ladner, 'St. Gregory of Nyssa and St. Augustine on the Symbolism of the Cross', in K. Weitzmann (ed.), *Late Classical and Medieval Studies in Honor of Albert Mathias Friend, Jr.*, Princeton, 1955, 88–95; H. Maguire, *Earth and Ocean: The Terrestrial World in Early Byzantine Art*, University Park, 1987, 29.
45 I Corinthians 1:18–25; J.L. Kovacs, *1 Corinthians: Interpreted by Early Christian Commentators*, Cambridge, 2005.
46 A.R. Brown, *The Cross and Human Transformation: Paul's Apocalyptic Word in 1 Corinthians*, Minneapolis, 1995, 8–11, 50–4, 89–104; Dinkler and Dinkler-von-Schubert (n. 40); R. Pickett, *The Cross in Corinth: The Social Significance of the Death of Jesus* (Journal for the Study of the New Testament Supplement Series 143), Sheffield, 1997; A.C. Thiselton, *The First Epistle to the Corinthians: A Commentary on the Greek Text*, Cambridge, 2000, 157–8.
47 I Corinthians figured prominently in the writings of Clement of Alexandria (*c.*AD 150–211/215), Origen (*c.*AD 185–254), Athanasius (*c.* AD 293–373), Gregories of Nyssa (*c.*AD 330–95) and Nazianzus (AD 329–89), John Chrysostom (*c.* AD 347–407), Cyril of Alexandria (*c.*AD 378–444) and Theodoret (*c.* AD 393–460). See, for example, Kovacs (n. 45); Thiselton (n. 46), 196–9.
48 Pseudo-Dionysios, *The Divine Names*, 865B–C: translated in Pseudo-Dionysios, *Pseudo-Dionysios: The Complete Works*, New York, 1987, 105.
49 Ibid., 865D–68A.
50 Revelation 21:18–20.
51 Corripus (n. 9), 76, 112.
52 Revelation 20:23.
53 Procopius I. 1. 30–1.
54 *Wisdom of Solomon* 7.26.
55 Schibille (n. 12).
56 J. Kollwitz, *Oströmische Plastik der Theodosianischen Zeit*, Berlin, 1941, 145–52; Maguire (n. 44), 73–80.
57 Janes (n. 41), introduction; G.B. Ladner, 'Medieval and modern understanding of symbolism: a comparison', *Speculum* 54 (1979), 223–56; E. Swift, *Style and Function in Roman Decoration*, Farnham, 2009, 2–10.
58 E. Borsook, 'Rhetoric of reality: mosaics as expressions of a metaphysical idea', *Mitteilungen des Kunsthistorischen Institutes in Florenz* 44 (2000), 3–18.
59 Schibille (n. 12).
60 Janes (n. 41), 103–7; P. Reuterswaerd, 'What colour is divine light?', in T.B. Hess and J. Ashbery (eds), *Light from Aten to Laser, Art News Annual* 35, New York, 1969, 108–27.
61 E.g. Pseudo-Dionysios, *The Divine Names*, 869A; *The Mystical Theology*, 997A–B: translated in Pseudo-Dionysios (n. 48), 107 and 135.
62 Elsner (n. 1); J. Elsner, 'The viewer and the vision: the case of the Sinai apse', *Art History* 17 (1994), 81–102; J. Miziolek, 'Transfiguratio domini in the apse of Mount Sinai and the symbolism of light', *Journal of the Warburg and Courtauld Institutes* 53 (1990), 42–60; R.S. Nelson, 'Where God walked and monks pray', in R.S. Nelson and K.M. Collins (eds), *Holy Image – Hallowed Ground: Icons from Sinai*, Los Angeles, 2006, 1–37; D. Westerkamp, 'Der verklärte Körper. Kleine Ästhetik der Mandorla', in *Drehmomente. Philosophische Reflexionen für Sybille Krämer*, Berlin, 2011, www.geisteswissenschaften.fu–berlin.de/v/drehmomente.
63 Pseudo-Dionysios, *The Celestial Hierarchy*, 337A–B: translated in Pseudo-Dionysios (n. 48); see also A. Andreopoulos, 'The mosaics of the Transfiguration in St. Catherine's monastery on Mount Sinai: a discussion of its origins', *Byzantion* 72 (2002), 9–41; E.D. Perl, *Theophany: the Neoplatonic Philosophy of Dionysius the Areopagite*, New York, 2007, 29–32.
64 Elsner (n. 1), 97–124; Elsner 1994 (n. 62).
65 Schibille (n.12).
66 For a similar interpretation of the mosaics in the Mausoleum of Galla Placidia in Ravenna see: Swift and Alwis (n. 2).
67 Procopius I. I. 27.
68 The *kontakion* was edited by C.A. Trypanis, 'Fourteen Early Byzantine cantica', *Wiener Byzantinische Studien* 5 (1968), 139–47; it was edited and translated in: A. Palmer and L. Rodley, 'The inauguration anthem of Hagia Sophia in Edessa: a new edition and translation with historical and architectural notes and a comparison with a contemporary Constantinopolitan kontakion', *Byzantine and Modern Greek Studies* 12 (1988), 117–67.
69 *Oikoi* 12–14; compare 1 Kings 5:12.
70 T. Preger (ed.), *Chronike Diegesis*, Leipzig, 1902.
71 Corripus (n. 9), IV. 280–4; Cameron (n. 9), 81, 115, 204–5.

Chapter 7
Mosaics and Materials
Mosaics from the 5th and 6th Centuries in Ravenna and Poreč

Claudia Tedeschi

Studies of mosaics from the 5th and 6th centuries have so far clarified many issues, although some are still in need of investigation. One of these is a comparison of specific segments of mosaic related to historical places where the mosaics are high quality expressions of religion and politics. Work on mosaics in Ravenna that have revealed many aspects of their particularities have with time become substantial and significant platforms from where such investigations can continue. It is a fascinating subject, especially when considered as valuable evidence of substantial historical, cultural and religious impact.

This paper starts with an examination of the technical and technological choices made during the construction of wall mosaics in Ravenna, Italy and Poreč, Croatia[1] with a special focus on some of the types of materials used by craftsmen in the mosaics of the 5th and 6th centuries. Other studies have already highlighted the relationship between the two geographical locations, which are characterized by places of worship from the same period, and also by a close affinity in their decorative language.

From the time of the Roman conquest to the subsequent Byzantine rule, the Istrian region was particularly concerned with the development of mosaics, especially during the time of Justinian and Maximian, a deacon in Pula, who was elected archbishop of Ravenna in AD 546, a position of unquestionable prestige and power.[2] The propagation of state ideologies was certainly extraordinarily effective, thanks in part to the role played by civil and religious architectural complexes. A 'world view' was permanently manifested through wall decorations of churches in the use of a common

Plate 1 Interior view of the apse in the Euphrasian basilica, Poreč

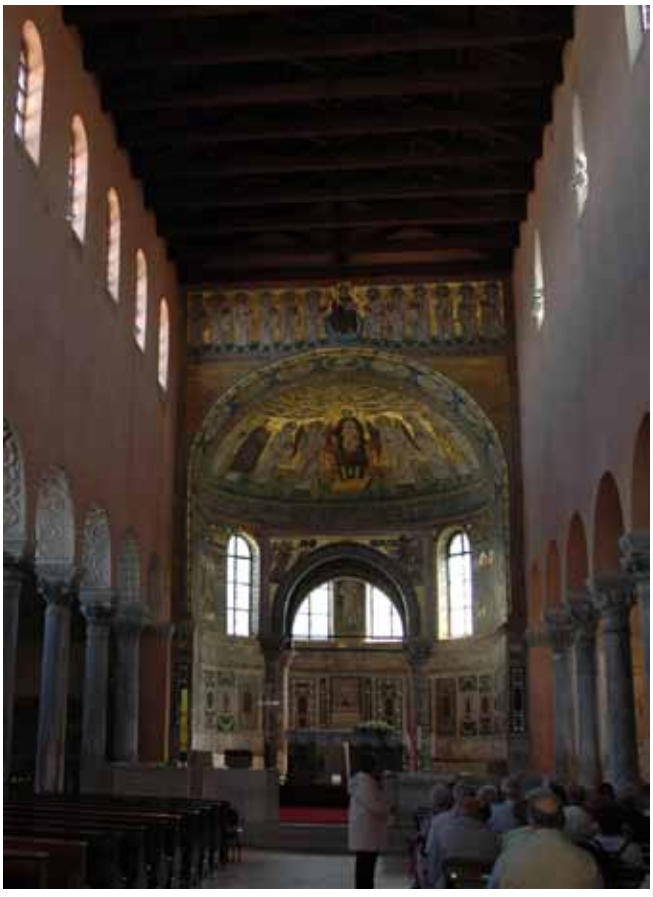


Plate 2 Detail of the face of Christ, Christ in the Garden of Olives, Sant'Apollinare Nuovo, Ravenna

Plate 3 Detail of the face of Christ, The Last Supper, Sant'Apollinare Nuovo, Ravenna

visual language evident throughout Byzantium (**Pl. 1**). In particular, the role of wall mosaics on the interior of Byzantine churches was both incisive and decisive for the spread of political and religious messages. The mosaics, which are still admired today, can certainly be viewed as the outcome of a perfect alignment between the languages of ideology and those of art and materials.

Some studies have already demonstrated this connection: analysis of the main arch in San Vitale during its restoration in 1990 showed a hierarchical connection between the importance of an area and the materials used.[3] In some circumstances there are strong connections between image, materials and chronology. In Ravenna, for example, the original parts of the late 5th-century mosaics (the Mausoleum of Galla Placidia, the Orthodox Baptistery, the Arian Baptistery and the Archbishop's Chapel[4]) are made exclusively of glass mosaics. At that time the only natural material in use was mother of pearl, which was used to give quality and richness to some of the iconographic details within the Archbishop's Chapel (the cross in the halo of Christ in the arch of the apse) or reused in 'composite' mosaics in some areas of the Orthodox Baptistery.[5]

The exclusive use of glass in these monuments undoubtedly testifies to a well-defined and important artistic culture as well as substantial economic means to fully supply the mosaic workshops. It is also important to note that new materials were introduced to the workshops in Ravenna and Poreč where natural raw materials (limestone and marble) and manufactured materials (clay/brick) were used with great success in the 6th century.

At first glance this change might be attributed to a new style and the decorative taste of the craftsmen who worked between Poreč and Ravenna. However, at the same time, changes and innovations are often directly connected with practical needs. In Ravenna, the new materials had already made an appearance in Theodoric's early 6th-century church of Sant'Apollinare Nuovo. Differences between the two walls of the nave can be seen in the distribution of natural and manufactured materials, which help to identify the different chronological stages of the execution of the mosaics. The two registers at the top on the north wall (showing the Christological scenes and the prophets) differ from the equivalent on the south wall in the use of pink limestone, used in the flesh tones of the figures, and in the introduction of white marble in the white sections.[6] The marble is white crystalline of medium to large particle size (possibly Proconnesian?), cut into large single cubes and used together with a limited amount of white glass.[7] In contrast, the mosaics in the upper registers on the south wall are made exceptionally almost exclusively of glass like earlier traditions of mosaics in 5th-century churches. This is with the exception of the scenes of Christ in the Garden of Olives (**Pl. 2**) and the Last Supper (**Pl. 3**), where some details in the face of Christ are in pink limestone.[8] Likewise, on the same wall in the representation of the *Palatium*, pink limestone is used in small concentrated areas of the tiles on the roof close to segments of orange glass. From this time on, white marble and limestone in various shades of pink – sometimes in white, as can be seen in the faces and hands of the female saints in Sant'Apollinare Nuovo[9] (**Pl. 4**) – become part of standard mosaic materials used by 6th-century mosaic workers: in fact in the churches of San Vitale, Sant'Apollinare in Classe and Sant'Apollinare Nuovo as well as in the Euphrasian basilica, such materials are used abundantly.

Before exploring the possible hypotheses for why this change occurred, it is worthwhile dwelling on some considerations about the construction phases of the mosaics of Sant'Apollinare Nuovo. Theodoric's church represents a turning point regarding the introduction of new technology of which the use of gold foil tesserae is a good example. In fact, in the late 1990s, during restoration of the mosaics[10] a peculiarity became evident in the three registers on the right wall: the gold backgrounds of the two upper registers (the Christological scenes and the prophets) contain small gold tesserae made of a glass support in greenish tones covered with rather uneven and cracked gold foil. In the lower register of the representation of Theodoric's palace and the city of Classe, a different type of gold tessera was used in abundance. The cubes are larger with support glass of a medium amber colour and the gold foil is spread evenly on the surface of the support. In the upper registers, the layer of glass (cartellina) that covers the gold has many fissures (so less able to keep the gold in place), while in the lower registers the cartellina are compact and transparent, ensuring therefore that they are in an excellent state of preservation.

In certain places both types of glass are used, such as in areas of the gold background of the palace.[11] Consequently, it

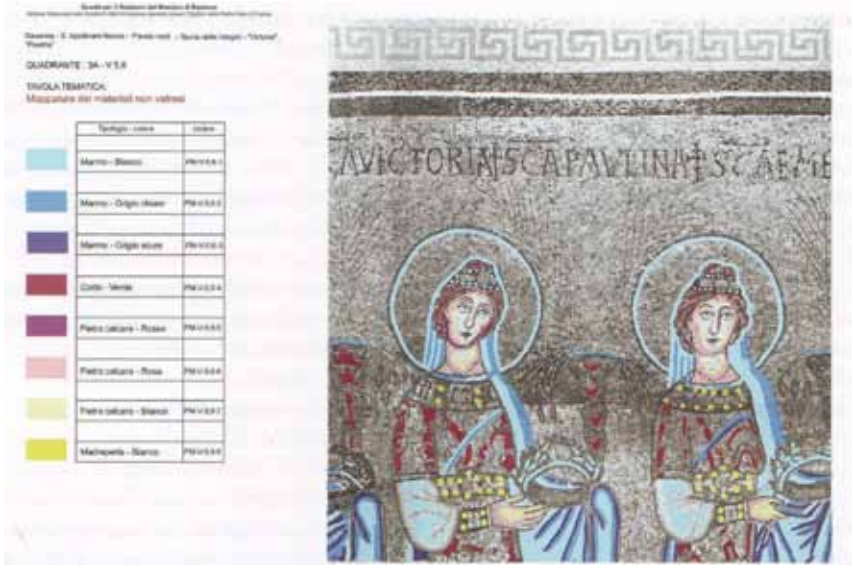


Plate 4 Thematic table of non-glass mosaic materials produced by the Scuola per il Restauro del Mosaico di Ravenna at Sant'Apollinare Nuovo, Ravenna

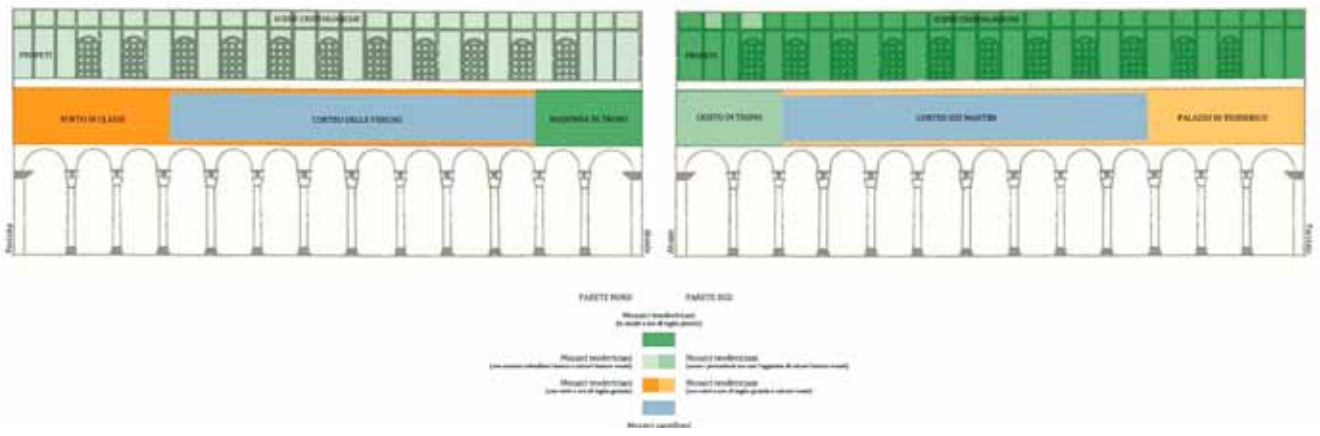
is assumed that the workers on the upper registers used gold tesserae with the greenish support and that they acquired the new amber-coloured gold tesserae at a later stage of the work. The presence of both types of gold glass in single coloured areas testifies to the use of the gold glass with a greenish support as a left-over from previous work. This technological shift in the manufacture of tesserae represents an important step since it establishes a chronology. The gold glass with the amber support remains in constant use during at least the 6th century, while the glass with the greenish support disappears. In light of these observations the occurrence of new materials (gold, limestone and marble) and their distribution on the surface could inform us about different phases of execution of the mosaics.

The covering of the walls with mosaics would have been carried out whilst taking advantage of the scaffolding holes in the walls left from the time of the original construction. We have to imagine the church as being built from the basic elements of foundations, walls and roof and as a complex building site. The heavy and fixed scaffolding was composed of vertical rods, longitudinal stringers, cross beams and boards.[12] The putlog holes on the north wall, which can be seen in photographs preserved in the photographic archive of the Soprintendenza per i Beni Architettonici e Paesaggistici of Ravenna,[13] allow us to estimate the approximate distance of the rods and in particular the levels of the working platforms.

The top level of the scaffolding was approximately in line with the bottom frame of the Christological scenes,[14] while below was another level placed approximately in the middle of the figures of the prophets. Although it remains hypothetical due to the lack of data, underneath this level there could have been another three levels:[15] one placed at the end with a painted area,[16] another positioned around the middle of the register of the Virgin and Christ and, finally, one at the base of this register. Furthermore it is likely that there were more levels at the height of the nave arches, but this is not possible to verify due to the massive 16th-century interventions that raised the floor, and consequently the columns, and removed a section of the wall.[17] It is likely that the whole scaffold was not covered simultaneously by planks of wood, but that these were transferred from one area to another as needed; it is also likely that some levels had a double layer of planks to withstand a possible collapse of a higher level.[18]

The construction of the nave mosaics started from the top down and, in the case of the south wall, from the west end towards the apse (**Pl. 5**). On that wall, therefore, the register of the Christological scenes and that of the prophets were the first to be made. This observation derives from direct

Plate 5 Summary table of the phases of execution of the mosaics in Sant'Apollinare Nuovo, Ravenna



analysis of the materials and techniques. All the scenes from the west to those representing Christ in the Garden of Olives and The Last Supper feature mosaic tesserae perfectly consistent with the tradition of Late Roman mosaics in Ravenna: the sole use of glass tesserae as well as rigorous and technical virtuosity. As mentioned above, in contrast to these, other scenes show changes through the introduction of pink limestone in the faces of the figures.[19]

We have to imagine a dynamic workshop site that had to take account of the cost of human resources and materials. This consideration leads us to believe that the execution of the work followed a consistent and flexible order and that the mosaic register could have been made following a horizontal/vertical pattern (the Christological scenes/the prophets). In other words, as the upper register of the mosaics were completed, the timbers of the scaffolding were dismantled and reassembled on the opposite wall. Here, there seems to have been a different team at work shown in the way in which the figures were rendered and in the widespread use of limestone of various shades of pink and of white marble used in the dress of several figures.[20] In the meantime, the mosaics in the registers with the depiction of Christ, the male martyrs and the royal palace were being finalized.[21] In fact, based on the materials used we assume that the last areas to be made were the depictions of the palace and the port of Ravenna since these areas only use the gold mosaics with the amber support.

The changes in materials introduced in this church are both interesting and revealing in their novelty. Were the reasons for the changes to do with new decorative tastes? Or was it because of a need to cover a shortage of certain materials? Answers to these questions have been sought in the analysis of certain raw materials in the production of glass mosaics and are extremely interesting. For the production of white, but also other colours, the raw transparent base glass required a mineral to make it opaque. Calcium antimonate was used as an opacifier in Roman times and its use continued at least until the 4th century. [22]

According to some experts, the availability of the opacifier ended at this time perhaps because of a shortage in the supply of the mineral. [23] However, this theory is currently being revised because it was based on too limited a number of analyzed samples. In light of new data the theory is too rigid and does not reflect reality. In fact, calcium antimonate can be found in mosaic tesserae from the 5th and 6th centuries, although one cannot exclude that it may be re-used material from earlier mosaics. It is significant, however, that in 5th-century mosaic glass-making technology other opacifiers such as tin oxide were also used.[24] In light of these considerations, was the introduction of marble and limestone materials the result of a lack of available raw materials or an inability to create new glass formulae? In either case the replacement of glass with natural materials was an advantageous solution since marble and limestone were of minor cost, readily available and could be recovered locally through the re-use of discarded objects.

Coming to an end of the work on the upper two registers on the right wall in Sant'Apollinare Nuovo, the workers had made use of all the available glass mosaic materials (white and pink), whilst leaving a reserve for the creation of the important parts lower down: Christ and the Virgin enthroned, the *Palatium* and *Civitas Classis*. These areas contain the exclusive use of white and pink glass, except for the use of white limestone in the faces of the angels and Christ and pink limestone in the roof of the palace (the details of which cannot be seen from ground level by the naked eye). That the two areas with the palace and the harbour were the last to be created appears to be, as previously stated, confirmed by the type of glass gold tesserae. Not only does the technology of production change (by the change of the colour of the glass support from greenish to amber), which suggests an improvement in aesthetic and material quality, but changes in the cut of tesserae from the upper registers (*c.* 0.5–1cm) to much larger sizes (*c.* 1–1.5cm) are also evident. These characteristics also apply to other mosaic glass tesserae like the green-coloured tesserae from Theodoric's reign at the base of the walls of the representation of Classe (**Pl. 6**).[25]

Concerning the original decoration from Theodoric's reign it is important to recall some of the considerations proposed by Francesco Lanzoni,[26] Corrado Ricci[27] and Giuseppe Galassi,[28] who speculated that the mosaics might have contained historical and political scenes of the Ostrogothic king that showed courtiers offering gifts to Christ and the Virgin in the space where the martyrs are now placed. In parallel, during restoration work of the mosaics in 1950, Giuseppe Bovini noted that the erased figures would have been placed against a gold background at the top and against a green background at the bottom.[29] The area investigated concerned a section at the level of the Vicenza Virgin,[30] which although in black and white and without measurements, clearly shows that the size of the gold tesserae, if seen from behind, are without doubt equal to the size of the tesserae found in representations of the building and the port of Classe and also in those mosaics made under the episcopate of Agnellus (**Pl. 7**).

This finding strongly suggests that the batch of gold tesserae with the amber-coloured support, in a larger size and in general of a superior quality, were used in the work of the lower registers after the completion of the segments with Christ and the Virgin.[31] The situation is interesting, as the whole political cycle of the mosaic would have been made at the time of a changing taste in style characterized by rather large cut tesserae placed next to small size tesserae (perhaps left over from the upper registers) and a new batch of gold. Is it plausible to think of a break between the completion of the religious and the political cycles? Where the rest of the mosaics are concerned they show standard themes of religious worship: the Testament scenes, the prophets, the enthroned Christ and the Virgin. In contrast, the segments with political messages needed to be discussed, chosen and decided upon.

Slightly less than half a century later in AD 561, Bishop Agnellus reconsecrated the church to Catholicism thereby manifesting the final victory over Arianism. The processions of male and female martyrs, as well as the Three Kings, replaced the previous mosaic cycles from the time of Theodoric; other mosaics were erased, such as the figures placed against the city wall of Classe, and those between the

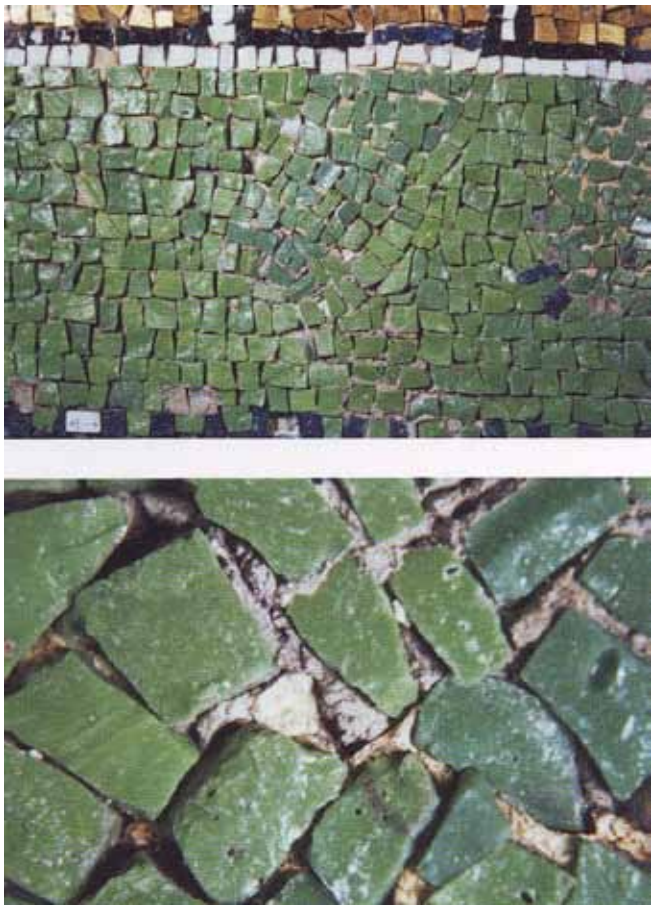


Plate 6 Details of the foot of the figure erased by Bishop Agnellus and the border between the mosaic from the time of Theodoric and that of Bishop Agnellus, Sant'Apollinare Nuovo, Ravenna

columns of the royal palace where they were replaced by images of knotted curtains.[32]

The major investigations by Bovini in 1950 aimed at establishing once and for all the origins of the mosaics. He noted that the first layer of mortar that adhered directly to the wall from Theodoric's reign had not been removed during the renovations carried out under Agnellus.[33] How was the workshop organized at this later time?[34] There is no doubt that the erasure of the figures was carried out with surgical precision: in fact the workers were able to remove very well-defined segments, as in the case of the figures placed against the city walls of Classe, or those between the columns of the building (the hands were left on the columns since they were not visible from ground level), or, finally, as on the whole of the lower registers (showing the male and female martyrs) where the workers cut away the mosaics from Theodoric's time from the background of the decoration.[35]

Agnellus' craftsmen still used natural materials but in larger amounts than previously. It is only in the representation of the female martyrs that there are three colours of marble: white, light grey and dark grey. Limestone colours range from white to almost red; mother of pearl is used to a great extent and with skill in the edges of the robes, the belts and the cuffs. A new manufactured material is introduced in these figures: tesserae of green clay brick[36] placed close to those of gold has been used to emphasize light/shadow.

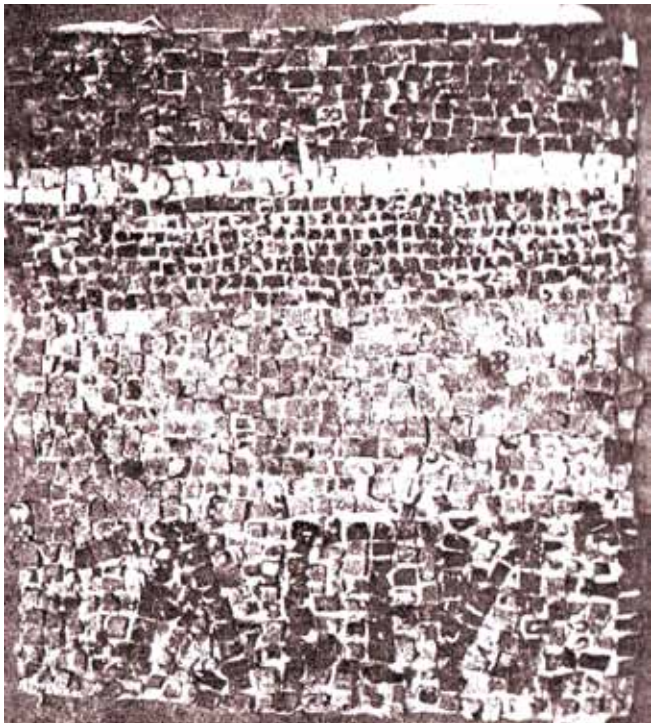


Plate 7 Mosaic segment removed during restoration work in 1950, Sant'Apollinare Nuovo, Ravenna

In this period mosaic techniques still show exceptional vigour due to a strong linguistic autonomy. There is no doubt that glass, marble, limestone and mother of pearl all have well-defined roles as mosaic materials and it seems that they are often used in juxtaposition with a particular material or colour that results in the development of a truly expressive style: the placement of pink limestone with cadmium orange, gold with yellow-green clay brick or white marble with white glass.

The mosaics of the basilicas of the 6th century are distinctive through the use of such formal characteristics: at Poreč an unusual black-grey limestone as well as a red clay brick, which in Ravenna can only be found in later interventions (**Pl. 8**).[37] The presence of black limestone in the Poreč mosaics shows very interesting issues particularly when compared with the conditions and history of its use in Ravenna. In the Euphrasian basilica this material is used in areas of less importance such as for the frames, in the

Plate 8 Detail of the border of jewels and frames from the original areas showing the use of red clay and grey limestone, Euphrasian basilica, Poreč

Plate 9 Detail of the border of stylized flowers from the original areas showing the presence of grey limestone in the apse, Euphrasian basilica, Poreč

Plate 11 Detail of shell-like motif from the original areas showing the presence of grey limestone in the apse, Euphrasian basilica, Poreč

register of shell-like motifs and in the ribbons of stylized flowers (**Pl. 9**). According to Ann Terry and Henry Maguire, these materials replaced more precious glass mosaics, such as red clay brick for red glass, grey limestone for blue glass. However, in the latter case, its use is more complex. On the one hand, we see black limestone used entirely in place of blue glass (for example at the bottom of the inscription that runs along the apse), on the other hand, the material seems also to have been used for its own value.[38] The strip of limestone that surrounds the figure of Zachariah (**Pl. 10**),[39] or in the pattern around or inside the shell-like motifs, (**Pl. 11**) further defines the space in which the motifs are represented. In the mosaics of the damaged smaller side apses, especially in the north apse, grey limestone was used in the blue glass background, again as an outline, where it improved the tonal transition between the two different colours (**Pl. 12**). As a further example of the presence of limestone in Poreč, Terry and Maguire found that the stone used at the bottom of the inscription of 'Severus' in the south apse is different to that used in other areas, as it is more of a brown colour.[40]

In Ravenna, however, as already mentioned above, the use of black-grey limestone is limited to the renovations carried out after the original mosaic was complete. The stone has been found in Galla Placidia, San Vitale, and in Sant'Apollinare in Classe where it shares some characteristics. The material has always been associated with subsequent interventions, far removed from the 6th

Plate 10 Detail of Zachariah from the original areas showing the presence of grey limestone in the apse, Euphrasian basilica, Poreč

Plate 12 Detail of the north apse from the original areas showing the presence of grey limestone, Euphrasian basilica, Poreč

Plate 13 Detail of the antique restoration, Galla Placidia, Ravenna

Plate 14 Detail of the antique restoration, north wall of the presbytery, San Vitale, Ravenna

Plate 15 Apse mosaic, San Vitale, Ravenna

century, when the constant remaking of the mosaics caused endless reinterpretations, and simplifications lowered the quality of execution.

The blue background in the west arm of the Mausoleum of Galla Placidia (**Pl. 13**), and the north wall of the presbytery of San Vitale (**Pl. 14**), show these exact characteristics: the background areas are characterized by the use of small quantities of blue glass (usually original or re-used from other contexts) and by the insertion of grey-black limestone. The additions tend to be uneven and there are fewer colours used. This results in simple, elementary forms, and are above all, far removed from the original exceptional mosaic productions of the 5th and 6th centuries where everything is made with precision and gravitas related to order and significance.

Different, however, is the condition of the apse of San Vitale (**Pl. 15**). Corrado Ricci observed the two lateral registers that comprise about half of the figures of San Vitale and bishop Ecclesius and reported the following:

> The scaffolds were raised in order to be able to observe the mosaics up close in the varying lights of day with the possibility of viewing individual tesserae, their position, the plaster and their level. Mosaicists Alessandro Azzaroni and Giuseppe Zampiga took part in the discussion with Santi Muratori and others and careful and meticulous exploration confirmed that it was ancient restoration, which we consider was done immediately after the work was complete, but which Muratori, without changing the overall conclusion, thought had been done before this stage. The disagreement thus seems to have been a question of minor points! Everyone agreed the following: that it is not restoration from the 10th, 11th or 12th century, but the results of reparative work carried out around the mid-6th century.[41]

Plate 16 Detail of San Vitale, apse mosaic, San Vitale, Ravenna

These areas, as noted by Ricci and still visible today, continue to convey the sense of being from a 6th-century mosaic. This can be observed mainly in the traditional expressive language of the mosaic, which has been made according to the established grammatical rules of the master mosaicists and the availability of mosaic glass in a variety of colours (**Pl. 16**). That said, black-grey limestone was used, most notably in the hem of the dress of San Vitale.[42] The limestone seems to have been used with awareness and for the specific purposes of creating the folds of the fringed hem and defining volume (**Pl. 17**).

Despite the ability of the skilled craftsmen and the quality of execution, there is an uncertainty in the composition which can be seen very clearly in, for example, the mantle of San Vitale where interconnected octagons surround circles with dots at the centre. The upper section, or rather, the section with original mosaic decoration, has a very definite geometrical layout executed with almost mathematical precision. Here the octagons are of a consistent size achieved by tesserae laid in parallel in horizontal and vertical lines, whereas on the slanting sides of the octagon the tesserae are placed at an angle of 45°. In contrast the restoration at the bottom of the mantle has resulted in the loss of exact definition: the octagons have become circles, their sizes differ, and the surrounding squares are sometimes rectangular; the end result is a less rigorous and accurate appearance.

The use of grey-black limestone, albeit in modest amounts, indicates the beginning of a profound modification of the mosaic language and a depletion of the raw materials traditionally used in wall mosaics. The extensive renovation, according to the chronology given by Ricci, testifies to interventions carried out on the original mosaic, although, as previously mentioned, still within the 6th century.

In San Vitale, this type of limestone appears for the first time in wall mosaics where it is used with skill and precision

Plate 17 Detail of the dress of San Vitale, apse mosaic, San Vitale, Ravenna

suggesting that the mosaic was executed by skilled craftsmen in Ravenna and who might already have had experience of using the material elsewhere. The connection with the other side of the Adriatic, at the Euphrasian basilica in Poreč, is tempting, although here the debate about the chronology and structure of the mosaics is still ongoing. In general, the chronology of the Poreč mosaics has been based on stylistic elements that have been compared with the Ravenna mosaic discussed here.[43] On this basis Terry and Maguire propose a chronological range between AD 526 (estimated date of the Arian Baptistery where colour similarity is found in some minor areas such as in bands or rows of tesserae) and AD 556 (the Justinianic phase of Sant'Apollinare Nuovo where there are typological similarities with the faces of male and female martyrs).[44]

In light of the observations made in this paper, the presence of black-grey limestone in Poreč and Ravenna could add a further element to the establishment of a chronology, which would obviously need validation by petrographic analysis of the stone samples from Ravenna and Poreč. Should such an analysis show that the material is the same it would suggest a later date for the Euphrasian mosaics, executed after the first mosaics in San Vitale. Accordingly, the workshop in Poreč would have introduced new materials such as grey-black limestone (but also one of a more brown colour) and red clay brick. Following the work here the craftsmen could have exported black-grey limestone to Ravenna where it would have been unknown to the craftsmen of the original mosaic. This scenario is certainly very tempting.

As mentioned above, after the 6th century the mosaics underwent a profound transformation, as can be observed in the renovations in Ravenna. The period is characterized by, for example, a lack of material in circulation; the re-use of tesserae either in their original state or re-cut in smaller dimensions[45] in order to increase the amount of tesserae available to use in new areas; or, the use of different coloured tesserae to compensate for the lack of materials.

It must also be mentioned that the renovation of the mosaics in the west arm of the Mausoleum of Galla Placidia and the north wall of the presbytery of San Vitale could have common origins. The blue background of the mosaics was treated in the same way using original tesserae mixed with other pieces of glass and black-grey limestone, irregular and rough settings, a variety in cutting and a lack of diversity of colours. It all amounts to a certain decadence in the mosaic language and subsequently to a profound transformation. The grammatical rigor in the 5th- and 6th-century wall mosaic is partially recovered in the Middle Ages, when the conditions change, especially in regards to the style and the relationship between the artist/creator of the mosaic and mosaic craftsmen.[46]

Notes

1 For the Euphrasian basilica see the excellent book by Ann Terry and Henry Maguire, which is the latest and most useful publication on the mosaics decorating the basilica: A. Terry and H. Maguire, *Dynamic Splendor: The Wall Mosaics in the Cathedral of Eufrasius at Poreč*, University Park, 2007.

2 C. Rizzardi, 'Relazioni artistiche fra Ravenna e l'Istria: i mosaici parietali', *Corso di cultura sull'arte ravennate e bizantina* XLII (1995), 817–36, esp. 818.

3 The use of two different types of gold foil glass are important in this connection. Tesserae with an amber-coloured support are of a better aesthetic and conservation quality than the other type which has a greenish coloured support. The 'best' gold foil tesserae are used in larger amounts, or even exclusively in important areas such as the background of the triumphal arch or in the halos of the most significant figures: C. Muscolino, 'Restauri ai mosaici parietali nel presbiterio di San Vitale', in *Quaderni della Soprintendenza* 2 (1997), 16–21, esp. 17.

4 I have purposely not included the church of Sant'Apollinare Nuovo which is from the end of the 5th century (phase from the reign of Theodoric) and the middle of the 6th century (phase from the reign of Justinian). The church merits a separate discussion as it represents a model for certain transformations in mosaic technology.

5 C. Tedeschi, 'La tecnica costruttiva della cupola e i materiali utilizzati', in C. Muscolino, A. Ranaldi and C. Tedeschi (eds), *Il Battistero Neoniano. Uno sguardo attraverso il restauro*, Ravenna, 2011, 55–71, esp. 58, fig. 1.

6 C. Muscolino, C. Tedeschi and E. Carbonara, *I mosaici di S. Apollinare Nuovo a Ravenna. Arte, Storia e Tecnica* (X Colloquio AIEMA), Conimbriga, 2005.

7 C. Muscolino, C. Tedeschi and E. Carbonara, 'Il restauro dei mosaici di Sant'Apollinare Nuovo a Ravenna. Un'occasione di approfondimento e di conoscenza dell'opera', in C. Fiori and M. Vandini (eds), *Ravenna Musiva. Conservazione e restauro del mosaico antico e contemporaneo* (Atti del primo convegno internazionale, Ravenna 22–4 ottobre 2009), Ravenna, 2010, 425–36, esp. 427.

8 G. Marchetti, *Il volto di Cristo nei mosaici di Ravenna*, Ravenna, 2011, 59, 61.

9 See the thematic table of non-glass mosaic materials produced by the Scuola per il Restauro del Mosaico di Ravenna in C. Muscolino, C. Tedeschi, E. Carbonara and E.R. Agostinelli, 'Dalle Tavole Storiche alle Tavole Digitali', in *La cura del bello. Musei, Storie, Paesaggi, per Corrado Ricci*, Milan, 2008, 353–69, esp. 364.

10 Restoration of the area was carried out by the Scuola per il Restauro del Mosaico di Ravenna under the direction of Dr Cetty Muscolino and restorers Claudia Tedeschi and Ermanno Carbonara.

11 E. Carbonara, C. Muscolino and C. Tedeschi, 'La luce nel mosaico: le tessere d'oro di Ravenna. Tecniche di fabbricazione e utilizzo', *Atti del Colloquio AISCOM*, Ravenna, 2000, 709–18, esp. 712.

12 C.F. Giuliani, *L'edilizia nell'antichità*, Rome, 1990, 196.

13 Archivio Fotografico Soprintendenza Ravenna, 1-A-4.

14 Other considerations that we can put forward in this connection concern an area in the gold background that runs along the apex of the arch of the windows across the length of the south wall. This area appears as a shadow likely to result from the angle of the tesserae which are irregularly placed and definitely not at the level of refined technique which characterizes the mosaics from

Theodoric's reign. Below the image representing Christ and the disciples at Emmaus there is a vertical misalignment of the geometric cornice which contains a depiction of a pair of birds.

15 This division is suggested by the height of the putlog holes in the masonry on the north wall and the pattern of mosaic decoration.

16 No trace of mosaic decoration has even been found in this area despite several examinations carried out under the direction of Corrado Ricci in 1899: *cf.* C. Ricci, *Per S. Apollinare Nuovo*, Ravenna, 1997 (anastatic edn), 110.

17 G. Gerola, 'La facciata di S. Apollinare Nuovo attraverso i secoli', *Studi e Ricerche su S. Apollinare Nuovo*, Ravenna, 1916, vol. II, 15.

18 Giuliani (n. 12), 199.

19 Pink glass tesserae may have been running low forcing the craftsmen to find alternative materials.

20 Muscolino, Tedeschi and Carbonara (n. 6).

21 We cannot know how the mosaics towards the west wall continued, but it is certain that the long row of male and female martyrs replaced other earlier mosaics from Theodoric's reign. What remains of the mosaics of the west wall is a fragment with a bust of Justinian which has had several modifications. The face, believed with good reason to be Late Antique, was made with limestone and glass tesserae. German scholars argued in the 1920s that originally the figure showed the Gothic king, Theodoric, not Justinian (*cf.* G. Bovini, 'Note sul presunto ritratto musivo di Giustiniano in S. Apollinare Nuovo di Ravenna', in *Annales Universitatis Saraviensis* I (1956), 50–3, esp. 52). According to this theory, Bishop Agnellus is supposed to have changed the representation during the conversion of the church. However, if the figure originally belonged to the phase of the Theodoric mosaics, the presence of limestone could be a problem, since this was not a stone in common use at this time. However, if the representation was done from scratch under Bishop Agnellus it would be in accordance with the rest of the mosaics from this period: the use of coral pink limestone in the cheeks of Theodoric/Justinian is linked to the same limestone used in the faces of female martyrs. However, the construction and style of the face throws doubt on the theory of the German scholars as there is nothing to link the materials for definite to either period.

22 M. Verità, 'Tessere musive vitree del Battistero Neoniano', in Muscolino, Ranaldi and Tedeschi (n. 5), 73–87, esp. 76.

23 W.E.S. Turner and H.P. Rooksby, 'A study of the opalising agents in ancient opal glasses throughout three thousand four hundred years', *Glastechnische Berichte* 8 (1959), 17–28.

24 Calcium antimonate has always been associated with natron glasses and this has led to the theory that the presence of the opacifier in glass produced after the 4th century came from the re-use of ancient glass. In fact, the discovery of calcium antimonate in combination with a glass based on plant ash used only from the 8th to 9th century confounds the idea of re-use, thereby extending the period in which antimonate was used: *cf.* Verità (n. 22), 74–7.

25 The detail of the remains of the feet of the figures that Bishop Agnellus erased and the border between the mosaics from the time of Theodoric and those of Bishop Agnellus are also illustrated in Muscolino, Tedeschi, Carbonara and Agostinelli (n. 9), 366.

26 F. Lanzoni, 'Studi storico-liturgici su S. Apollinare Nuovo', *Studi e Ricerche su S. Apollinare Nuovo* II, Ravenna, 1916, 83–98, esp. 93.

27 C. Ricci, *Guida di Ravenna*, Bologna, 1923 (6th edn), 115.

28 G. Galassi, *Roma o Bisanzio*, Rome, 1929, 125.

29 G. Bovini, 'Antichi rifacimenti nei mosaici di S. Apollinare Nuovo di Ravenna', *Corso di cultura sull'arte ravennate e bizantina* XIII, Faenza, 1966, 51–81, esp. 54.

30 See his published photograph in ibid., fig. 7.

31 It is obvious that we are not able to determine with certainty at what point the batch of gold mosaics changed as the extensive 19th-century restorations removed any information about this on both walls forever. It would have been interesting to see the point of change between the register of the Virgin enthroned and that of Christ which is made with small gold tesserae with a green support base and a golden area from Theodoric's reign which is made with larger tesserae with an amber-coloured support.

32 See n. 29.

33 *Cf.* G. Bovini, 'Una prova di carattere tecnico dell'appartenenza al ciclo iconografico teodoriciano della madonna in trono, figurata sui mosaici di S. Apollinare Nuovo a Ravenna', *Studi Romagnoli* 3 (1952), 19–26.

34 As observed by Bovini the mosaicists who made the new mosaics of the processions of the male and female martyrs worked on the top layer of old plaster. It is however important to note that he based his investigation on a limited surface area and it is therefore not possible to say if his observations are valid for the whole area renovated by Bishop Agnellus. Indeed, it is reasonable to assume that these workers may have had some difficulty in tracing the scaffolding holes on the wall as this would have been covered by plaster from Theodoric's era. But it is equally possible that the register with painted decoration (where no antique decoration has ever been found) may have been a suitable place for anchoring the scaffold.

35 The gold section at the top and the green at the bottom were spared from the demolitions carried out under Bishop Agnellus, in fact, it is still possible to trace the border between the two phases of mosaics.

36 See n. 9 and **Plate 4**.

37 These materials have been identified by Terry and Maguire in areas that are considered original: Terry and Maguire (n. 1), pls 136–9, 86–7.

38 The surface of the stone is today somewhat modified by a whitish tinge which is due to natural alteration. We are unable to identify the exact type of stone due to a lack of petrographic analysis. It is currently suggested to be slate: Muscolino (n. 3), 18; Terry and Maguire (n. 1), 80. Were analysis to confirm that it is slate, it would be interesting to identify the quarries in order to complete the data. It may be remarked that in Liguria the stone is extracted in several places: it may have been transported in the Adriatic area using the ancient roads that joined the Via Postumia, the great road that connected Genoa with Aquileia, thereby linking the Tyrrhenian west with the Adriatic east through the Po Valley.

39 Terry and Maguire (n. 1), pls 107, 239, 69, 154. The border in grey limestone on the blue background that surrounds the upper part of that panel has been judged to be original although the border is interrupted at the shoulders of the saint. In fact, the chart that shows discreet areas of mosaics that have had different interventions, demonstrates that there were numerous of these in this area and that the abruption is a result of earlier interventions: it does not correspond to the criteria of expressive order and structure which the mosaics of this period otherwise show.

40 It is obvious that all the considerations made on materials require further analysis. It would be desirable to carry out petrographic analyses in order to establish the exact nature of the stone and any connections between the different places.

41 C. Ricci, *Per San Vitale*, Ravenna, 1996 (anastatic edn), 102–3; C. Ricci, *San Vitale, Tavole storiche dei mosaici di Ravenna*, Rome, 1935, pl. LXV.

42 The inspection has been carried out by the author from the pavement of the church with the use of photographic equipment.

43 G. Bernardi, *I mosaici della basilica eufrasiana di Parenzo: documenti per la storia dei restauri (1862–1916)* (Collana degli Atti, Centro di Ric. Stor., Rovigno no. 24), Trieste, 2006, 11–20.

44 Rizzardi (n. 2), 817–36; Terry and Maguire (n. 1), 68–9, 127–31.

45 Muscolino (n. 3), 18.

46 I refer here to the so-called Roman school of the 13th century with work by Jacopo Torriti (Santa Maria Maggiore, San Giovanni in Laterano), Pietro Cavallini (Santa Maria in Trastevere) and Filippo Rusuti (the old facade of di Santa Maria Maggiore).

Table 1 Summary of the monuments in Ravenna and the mosaic materials used

Building	Dates	Original Materials	Antique materials used in renovations
Galla Placidia Mausoleum	After AD 450	Mosaic glass	Other types of glass Grey-black limestone Pink limestone Green-yellow clay brick White marble
Orthodox Baptistery	Beginning of 5th century Neonian period (AD 450–75)	Mosaic glass Mother of pearl (left over)	
Arian Baptistery	Theoderic (AD 493–596)	Mosaic glass	Unknown*
Archbishop's Chapel	Bishop Peter II (AD 494–519)	Mosaic glass Mother of pearl	Unknown*
Sant'Apollinare Nuovo	Theoderic End of the 5th, beginning of 6th century	North wall: Mosaic glass Yellow clay Pink limestone South wall: Mosaic glass Yellow clay brick White and pale pink limestone White marble	
San Vitale	AD 530–47	Mosaic glass White limestone White and pale pink limestone Yellow clay brick Green clay brick Mother of pearl White marble Grey marble	Other types of glass Grey-black limestone
Sant'Apollinare in Classe (the surface of the triumphal arch facing the nave)	AD 549	Mosaic glass White and pale pink limestone Red clay brick White marble Grey marble	Other types of glass Grey-black limestone Pink limestone
Sant'Apollinare Nuovo	Justinian AD 556	Mosaic glass White and pale pink limestone Yellow clay brick Mother of pearl White marble Grey marble	
Euphrasian basilica	Ecclesius (6th century) AD 526–56 as proposed by Terry and Maguire	Mosaic glass Grey and black/brown limestone White limestone Pink limestone Yellow clay brick Red clay brick Mother of pearl White marble Grey marble	Unknown*

*It has not been possible to verify the presence of specific materials in the areas of antique restoration.

Chapter 8
A Study of Glass Tesserae from Mosaics in the Monasteries of Daphni and Hosios Loukas

Rossella Arletti

Introduction

At the end of the first millennium, several changes affected glass manufacturing processes. One of the most significant was that between the 9th and 11th centuries in the Mediterranean area, natron started to be replaced by halophytic plant ashes as a fluxing agent. The change in the flux employed was not abrupt but went through a series of experiments, which led to an intermediate situation represented by the so-called 'mixed natron-plant ash composition' glass. This intermediate type of glass has been recognized at Middle Eastern[1] and Italian[2] sites from the 10th and 11th centuries. The effects of the change in glass technology can be seen in the mosaic tesserae from the basilica of Santa Maria Assunta on the island of Torcello, as reported by Irina Andreescu-Treadgold and Julian Henderson.[3] The question is whether the intermediate composition was the result of the addition of natron glass cullet and scrap to the glass batch,[4] or if it was obtained as a primary fusion by directly mixing natron and plant ashes as raw materials.[5] The present study of 11th-century Byzantine mosaic tesserae represents a further step towards an understanding of the changes of the fluxing agent in opaque glass production.

Along with the changes recorded in the type of fluxing agent, other variations typically connected with opacifiers or colouring elements accompanied the evolution of mosaic glass production. Different compounds were used through the centuries to make glass opaque. Antimony-based opacifiers (yellow lead antimonates and white calcium antimonate) were used from the beginning of glass production in the Near East and Egypt around 1500 BC[6] to the Roman era.[7] Although tin oxide was first introduced as an opacifier as early as the 2nd century BC,[8] it was during the 4th century when tin-based opacifiers started systematically to replace the antimony-based ones [9] from the eastern Mediterranean through into northern Europe.[10] Tin-based opacifiers were also used in Italy from the 5th century onwards, but at the same time antimony-based opacifiers continued to be used (or reused) and disappeared around the 13th century.[11]

In this paper the results of the analyses performed on the mosaic tesserae coming from the Greek monasteries of Daphni and Hosios Loukas reported by this author[12] and Cesare Fiori[13] are considered and discussed. Fifty-one glass mosaic tesserae from the well-dated Byzantine wall mosaics from the two monasteries were studied. The choice of samples was determined by their colour and most of the colour shades present in the mosaics were sampled and studied. Obviously, the tesserae could belong to the original mosaic decoration (11th century), but could also be reused tesserae from previous mosaics or the result of restoration executed in subsequent times. For this reason it is fundamental to discriminate between the tesserae of the original decoration and those from other periods.

In this paper I will discuss the distinctive traits of the medieval tesserae belonging to the original decoration for each mosaic. Subsequently a comparison of the chemical data of the two mosaics will help us understand if the glass from the two Byzantine mosaics could be the result of the same production technology. In addition, the opacifiers and

colouring elements employed for the production of this glass will be examined.

Historical issues

Monastery of Daphni

The Monastery of Daphni is located 10km from Athens, on the 'Sacred Way' leading to the Sanctuary of Eleusis. The most probable hypothesis for the origin of its name is that the monastery is situated on the site of a temple dedicated to Apollo Daphne.[14] The first document attesting to the presence of the monastery is from 1048[15] and other sources mention dates from the end of the 11th to the early 12th century. Architectural elements from the 5th to 6th century indicates that the monastery had been rebuilt on the foundations of a former basilica, which in turn had been constructed on the base of a pagan cult building.[16] There is no information about the basilica, so the site is presumed to have been abandoned from the 7th century until the monastery was rebuilt in the 11th century and decorated with magnificent mosaics by an unknown artist. These mosaics are considered to be one of the most important mosaic cycles from the Middle Byzantine period as they are evidence of the iconographic and stylistic conceptions formulated at the end of the iconoclastic crisis (AD 843) by the Church of Constantinople. The decoration shows a rigorous consistency in the distribution of subjects, characteristic of Constantinopolitan art, with its principles derived from metropolitan theological doctrine.[17] There is no information regarding the origin of the mosaic artists, although the quality of the decoration suggests that the workers came from the capital.[18]

The first important modern restoration was carried out in 1888. Other restoration work was conducted in the years 1955, 1959–60, and 1972 under the aegis of the Byzantine Antiquities Office of Greece. Recent interventions have also involved the mosaic decoration.

Monastery of Hosios Loukas

The Monastery of Hosios Loukas is located in the region of Phocis, 35km from Delphi near the ancient town of Stirio, an area dominated by Mount Parnassus. The complex is dedicated to St Loukas Stiriotis, a hermit monk who lived between AD 896 and 953,[19] and was built in the 10th century. The reconstruction of the monastery's history is based on a biography of the saint by an anonymous disciple after AD 961. The chronicle recounts how Loukas, accompanied by several faithful monks, arrived in the region of Phocis where his subsequent fame as a faith healer drew the attention of benefactors who supported the construction of the first part of the monastery. Further changes and additions radically changed the appearance of the monastery. The monastery, which is surrounded by an irregular wall, consists of three buildings: two churches (the Theotokos and the adjacent katholikon) and the refectory (the *trapeza*), which is now used as a museum. The Theotokos, completed in AD 955, is one of the first examples of the cross-in-square church: it has three apses, one narthex and an exonarthex with a large dome, with the typical characteristics of the Middle Byzantine period.[20] The katholikon is a domed octagonal church, most renowned for its mosaics which represent one of the most complete examples of the iconographic and stylistic conceptions formulated in the post-iconoclastic period, based on the perfect balance of architecture and decoration.[21] It is possible to state with a fair degree of confidence that both the church and its mosaics and frescoes were completed in the 11th century.[22] The extraordinary mosaic decoration in the upper part of the church, dated to around 1040, was executed by mosaicists from Constantinople.[23] Both restoration and reconstructions at the monastery are documented from the end of the 19th century. A restoration programme was started in 1939 with the aim of conserving the katholikon and cleaning its mosaics.[24] After the damage caused by the Second World War, further restoration was conducted between 1958 and 1964.

Results and discussion

Daphni tesserae

All the analyzed samples are made of silica glass with sodium as the main fluxing agent (Na_2O ranging from ~7 to ~18 %) but some differences are recognizable among the samples.

An initial distinction in the tesserae from Daphni can be made between glass containing lead and glass in which lead is not detectable or is found at a negligible level (PbO less than about 0.2%). In the historical period considered here, the presence of lead is a characteristic specific to mosaic glass (or, more generally, of strongly opaque coloured glass). Its addition is a response to artistic requirements since, besides lowering the melting point of the batch, it allows particular colours to be obtained and enhances the brilliance of the glass.

Lead is a common component of opaque glass because, when present in the form of lead antimonate ($Pb_2Sb_2O_7$), it confers a typical opaque yellow shade, and, if combined with copper or cobalt, can create a green shade.[25] Significant levels of lead oxide, exceeding 1–2% can also be found in opaque red glass. Numerous studies performed on opaque red glass tesserae[26] show that the addition of Pb or Fe as reducing agents was a common practice in the production of ancient glass to induce copper reduction to metallic Cu or cuprous oxide.

The Pb-bearing glass from Daphni has compositions that are not easy to interpret as most of the samples exhibit features that are not consistent with the period, raising the issue of their origin. The diagrams showing levels of CaO-Al_2O_3 (**Fig. 1**), usually adopted to discriminate between different silica sources, show that, on average, the glass containing lead is characterized by lower contents of both elements indicating that they were produced from different raw materials. The diagram showing levels of K_2O-MgO (**Fig. 2**), used to discriminate between different sources of fluxing agents, shows that almost all the lead-free glass tesserae (with few exceptions) are characterized by levels of K_2O and MgO ranging from ~1.5 to ~3 % of both elements. These values are slightly lower than those assumed to be an indication of the use of plant ashes as a flux and higher than those indicating the use of natron, that is MgO

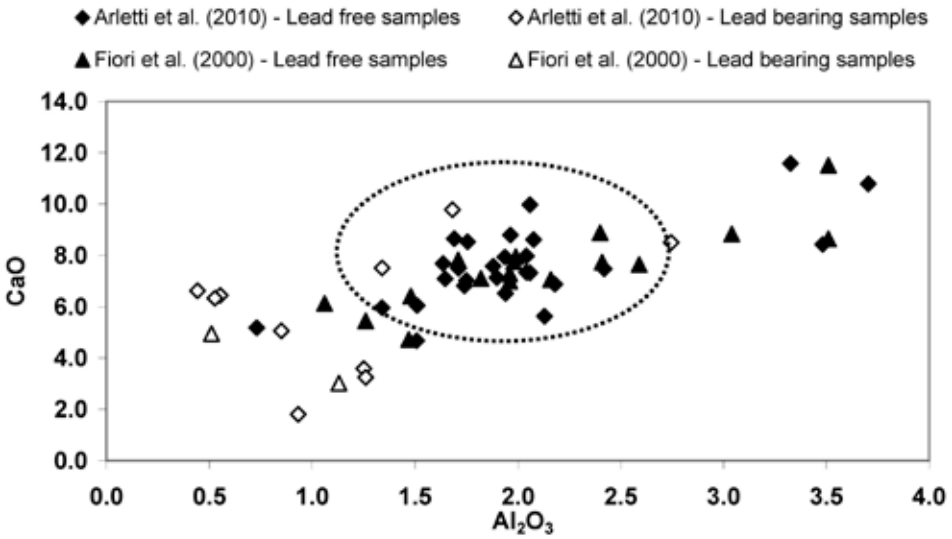


Figure 1 CaO vs Al_2O_3 for the Daphni samples. Dashed ellipse represents the field of original tesserae

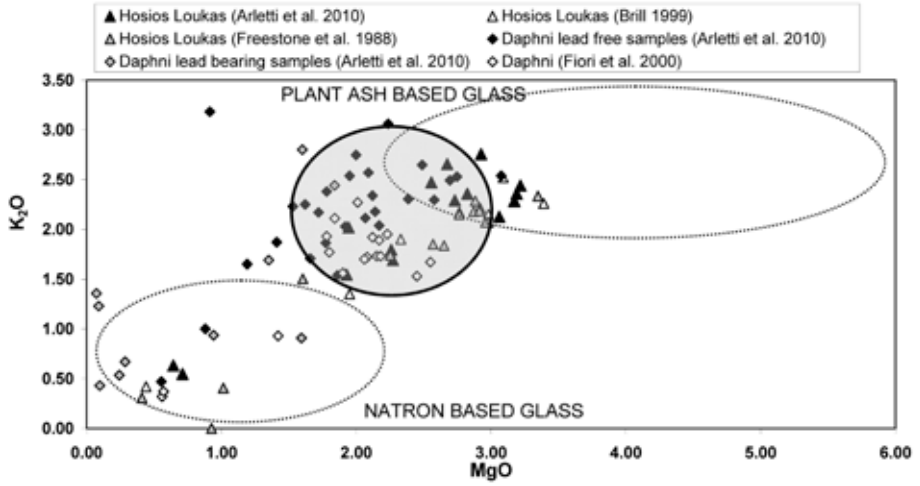


Figure 2 K_2O vs MgO for the Daphni and Hosios Loukas samples. The fields relative to the compositions of natron-based and plant ash based glass are reported. The composition field found for mixed plant ash-natron based glass in Torcello[28] is represented by the grey circle

and K_2O higher than 2%.[27] Regarding the lead-rich tesserae, the situation is different: most of the samples show lower levels of MgO and/or of K_2O while the few exceptions fall in the field of the lead-free glass.

Other chemical features indicate that some of the Pb-bearing tesserae should be considered as outliers: for example, some of the green samples contain chromium, and it is well known that Cr has only recently been introduced in modern glass technology (about 150 years ago), so its presence is a clear sign of non-original tesserae.

The group of lead-free tesserae appears more homogeneous and the samples with anomalous characteristics seem to be far fewer than in the Pb-rich glass group. Except for the differences in the chemical data given by the presence of different chromophores, only a few samples can be distinguished and could be considered as non-medieval on the basis of the low levels of potassium and magnesium and/or high CaO and Al_2O_3 contents (**Figs 1** and **2**).

Regarding the minor elements, due to the strong colour of most of the samples and to the wide variety of colour nuances, large differences are present in their chemical data, particularly in regard to the transitional metals. Manganese is present in almost all the samples, with the highest values always related to violet samples. Iron is present in all the tesserae in a wide range of levels: the higher percentages of its oxide, clearly indicating intentional additions, characterize the red-brown and black samples. All the green samples show high percentages of copper oxide and iron, with some exceptions showing high levels of Cr (see above). High percentages of copper oxide are also associated with the red and brown samples. The content of cobalt is very low in the whole sample set: the highest values of CoO (~0.08–0.11%) are related to the blue glass samples. Antimony oxide was detected in very low levels (Sb_2O_3 <0.1%) in most of the samples; the highest values, exceeding 0.7% were found in some of the lead-bearing green and blue glass. The main opacifiers found in the Daphni tesserae are metallic copper in the red brown ones and quartz and crystobalite aggregates in the blue, purple and grey samples. In addition calcium antimonate ($Ca_2Sb_2O_7$) was found in a blue as well as in a green tessera and $Pb_2Sb_2O_7$ in a dark-green one.

Table 1 displays the data for the basic glass composition of the tesserae pertaining to the original decoration. The peculiarity of the medieval group of glasses is the type of fluxing agent: the chemical data relative to MgO and K_2O lie between the two distinct fields of the typical natron and plant ash glasses. The comparison of the data from Daphni with that from Torcello[28] – the compositional field is reported in **Fig. 2** with a grey circle – confirms the hypothesis that the medieval glass from Daphni is a 'mixed natron-plant ash soda-lime' glass. This type of glass, considered to be the result of a transitional technological

	Daphni			Hosios Loukas		
	Average	St. Dev.	Min-Max	Average	St. Dev.	Min-Max
SiO_2	69.81	3.67	62.11–78.56	68.78	2.49	65.29–76.07
TiO_2	0.10	0.03	0.09–0.41	0.09	0.01	0.08–0.12
Al_2O_3	1.90	0.32	1.51–2.42	1.59	0.20	1.40–2.09
MgO	2.02	0.46	1.19–3.07	2.73	0.53	1.60–3.39
CaO	7.52	1.01	5.63–9.97	8.3	0.93	6.78–9.44
Na_2O	11.19	2.06	7.16–13.88	12.21	1.61	11.12–16.69
K_2O	2.30	0.38	1.54–3.06	2.04	0.45	1.35–2.76
P_2O_5	0.27	0.08	0.11–0.39	0.27	0.06	0.18–0.36
S	0.09	0.04	0.05–0.15	0.14	0.03	0.09–0.19
Cl	0.68	0.17	0.38–1.04	0.84	0.18	0.46–1.14

Table 1 Average composition of the samples from the Daphni and Hosios Loukas mosaics after the exclusion of the 'non-original' tesserae

phase, was first recognized at the late 8th to 9th century Syrian glass production site of Raqqa, where Julian Henderson found evidence of the primary fusion of plant ash and natron glass.[29] By the 11th century, however, plant ash had became dominant at this inland Middle Eastern site, suggesting that natron was no longer available far from the Mediterranean coast. Other clear evidence of mixed natron-plant ash glass is found in the 11th-century Islamic glass from the Serçe Limanı shipwreck,[30] where this is the prevailing type, suggesting that the production centres located on the Levantine coast (where the ship is supposed to have been loaded) could rely on large deposits of natron glass. In the case of mosaic glass its use can be observed quite late on, since the medieval tesserae from Daphni were taken from mosaics dated no earlier than the mid-11th century. Their chemical characteristics are far more similar to the medieval Torcello mosaic glass or the Serçe Limanı mixed natron-plant ash than to the same glass from Raqqa. This could be seen as a sign that the natron glass had been recycled. It can thus be assumed that the medieval tesserae of the Daphni monastery were produced by mixing plant ash glass with recycled natron-based glass, possibly at a coastal Middle Eastern production site. Only a few samples show the composition typical of plant ash type glass[31] with contents of K_2O and MgO just slightly higher than 2.5%. In these samples the content of Na_2O (> 13%) is definitely higher than the average value (about 11%) of the Pb-free tesserae. Therefore, for the production of these samples a higher content of flux was used.

On the basis of the chemical data discussed above, most of the glass that contains varying percentages of lead displays anomalous behaviour. These non-original tesserae could be further divided into: i) natron-based glass, possibly re-used tesserae, characterized by low MgO and K_2O levels; ii) modern glass (19th century), characterized by low MgO and K_2O and the presence of Cr; co-presence of Sb and Pb not usually employed in the production of blue ancient glass; and very low levels of Al_2O_3 (lower than 1%) deriving from the use of a very pure source of silica.

Along with these examples of lead-bearing glass, other lead-free samples show an anomalous composition distinguishable only on the bases of the high levels of CaO and Al_2O_3.

Hosios Loukas tesserae

Along with the data reported by the author,[32] results recorded by Robert Brill[33] and Ian Freestone[34] were also considered for the present study since they represent a useful tool for the definition of the main group of the original tesserae.

All the samples from Hosios Loukas analyzed here are silica-soda-lime glass and lead oxide was detected only in very low levels, never exceeding a weight of 0.1%. The levels of Al_2O_3 and CaO range (for almost all the samples) from ~1.5 to ~2.0% and from ~ 6.5 to 9% respectively (**Fig. 3**). These values represent the usual concentrations found in mosaic glass of the Byzantine period. Only six samples analyzed in the three different papers present lower levels of these two oxides. Regarding the percentages of K_2O and MgO (**Fig. 2**), it is possible to exclude an exclusive use of a pure mineral source of alkalis since some of the glasses are of the 'mixed natron-plant ash' type and the majority lie in the plant ash compositional field. These levels could indicate either the use of plant ash as a source of flux along with the recycling of older natron-based glass or the addition of both plant ash and natron as sources of alkalis. Once again, the six outliers show lower levels of CaO and Al_2O_3 when compared with the main group. This is indicative of the use

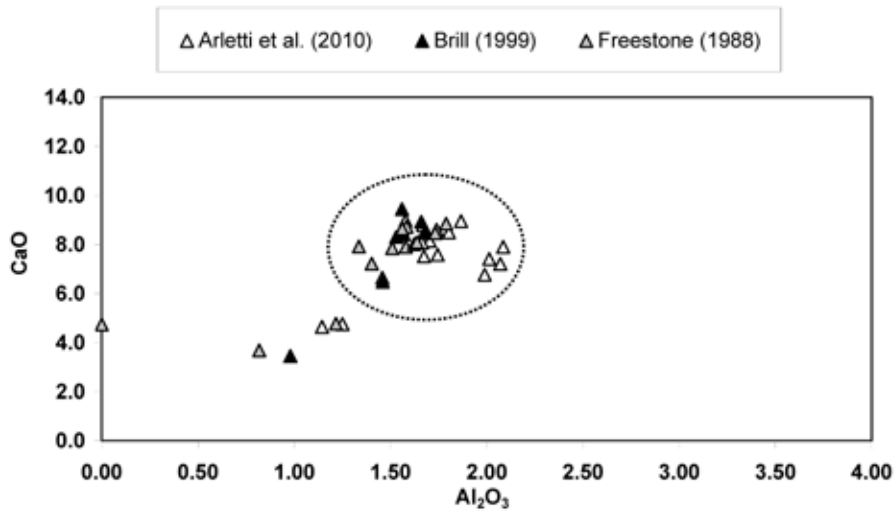


Figure 3 CaO vs Al_2O_3 for the Hosios Loukas samples. Dashed ellipse represents the field of original tesserae

of different raw materials for both the silica and fluxing components. It is interesting to note that all these six samples are blue and, in addition, it is observed that they are the only ones almost Mn-free (MnO < 0.1%). This could indicate that either all these outliers do not belong to the medieval group but represent the re-use of older natron-based tesserae; or that one or more of the manufacturing sources for blue glass was distinct from the production of the other colours. The average composition of the main group of samples from Hosios Loukas is summarized in **Table 1**.

The large variety of hues reflects the presence and coordination chemistry of the transition metals. The levels of iron oxide are rather higher, often exceeding 1% of weight: the highest values are for the black, blue and red samples. Manganese, measured in rather high levels in all the samples (with the exception of the three outliers), is present in highest amounts in the brown and light brown samples. In these cases the relatively high percentages of oxidized manganese could be the origin of the brown shades. But it cannot be discounted that the colour in these samples is due to the presence of sulphide ions substituting oxygen in the coordination sphere of Fe^{3+}. MnO is also present in quite high levels in the colourless and very light green samples. In these two latter tesserae it acts as a decolouring agent, since no Sb was detected and the levels of iron are rather high for colourless samples. Regarding the other colouring elements, as expected the highest CoO levels are in blue samples, while CuO is more concentrated in the red and green samples. Copper is also present in all the blue samples, even if at lower levels. The main opacifier used in the production of the tesserae from Hosios Loukas was quartz crystals. In addition, the presence of cristobalite is reported for some samples. The red samples owe their colours and opacity to the presence of metallic copper particles dispersed in the glass matrix.

The case of the tesserae from the Monastery of Hosios Loukas appears to be quite different from those of the Monastery of Daphni: the majority of the glasses from Hosios Loukas are of the plant ash type, while a smaller group is made of mixed natron-plant-ash glasses; few samples are of the natron type and, as previously discussed, can be considered as a re-use of tesserae. As for the 'mixed natron-plant ash' glass from Daphni, compositional similarities are found with 11th-century Middle Eastern production, to which the Torcello tessera have also been ascribed.[35] The difference in the dominant type of glass confirms once more that the 11th century was a time of important technological change in glass production.

Conclusion

The compositional fields of the original tesserae from Daphni and Hosios Loukas are summarized in **Table 1**. Only a few cases of non-medieval tesserae were identified in the Hosios Loukas sample set, possibly corresponding to the re-use of formerly produced natron glass.

In general, all the medieval samples analyzed here are silica-soda-lime glass, the lead-bearing tesserae being of ambiguous chronological definition. The predominant type of medieval glass from Daphni is a mixed natron-plant ash soda-lime glass; only a few samples do not perfectly fit this category, being closer to the plant ash type. Nonetheless, since these samples are characterized by a slightly higher content of flux, it can be assumed that they do not pertain to a different production. On the contrary, the glasses from the Monastery of Hosios Loukas can be separated into two sub-groups: the mixed natron-plant ash type and the plant ash type (this latter with K_2O exceeding 2% and MgO exceeding 2.5–3%).

The main differences between the samples of the two localities are the content of Na_2O and, less importantly, the content of MgO, with the highest values always from the Hosios Loukas samples. Despite these slight variations in alkali content, it can be assumed that the medieval tesserae from both sites were produced either by obtaining a plant ash glass (predominant for Hosios Loukas) or a mixed natron-plant ash glass by the addition of recycled natron-based glass. Regarding the levels of CaO and Al_2O_3, the percentages found in the Hosios Loukas tesserae are included in the ranges found for the Daphni samples, even if, on average, the higher values of CaO are from the Hosios Loukas samples. The average for Al_2O_3 is higher in the Daphni tesserae. It is well known that in natron-based glass, which is produced with siliceous calcareous sand, the content of lime is related to the presence of limestone in the sand or to the addition (intentional or unintentional) of shells. On the contrary, in plant ash glass a discrete quantity of lime is also present in the ashes used as a flux. The cause of the higher content of Al_2O_3 in the Daphni tesserae is probably to be found in the use of a feldpatic-rich silica source. The 11th century is considered as a 'bridge' between natron type and plant ash glass since it is exactly at that time in sites in both the western and eastern Mediterranean that the 'mixed natron-plant ash' glasses testify to this technological change. The observed differences between the two groups could be explained by supposing that two different glass production sites, probably located on the Levantine coast, or the same site at varying times, could rely on different stocks of raw materials. Considering that the technological evolution is linked to the availability of raw and recycled materials, it is possible that for the production of the tesserae of the Hosios Loukas monastery, the amount of recycled natron glass available was lower compared to that available for the Daphni mosaics. This would lead to the conclusion that the tesserae were manufactured starting from raw glass produced at different sites or from different melts produced at the same site.

Acknowledgements

The author would like to thank Dimitrios Chryssopoulos for providing the samples. This work is the result of a collaboration with Cesare Fiori and Mariangela Vandini (University of Bologna, Italy).

Notes

1 J. Henderson, S.D. McLoughlin and D.S. McPhail, 'Radical changes in Islamic glass technology: evidence for conservatism and experimentation with new glass recipes from early and middle Islamic Raqqa, Syria', *Archaeometry* 46 (2004), 439–68.

2 M. Uboldi and M. Verità, 'Scientific analyses of glasses from late antique and early medieval archaeological sites in Northern Italy', *Journal of Glass Studies* 45 (2003), 115–37.

3 I. Andreescu-Treadgold and J. Henderson, with M. Roe, 'Glass from the mosaics on the west wall of Torcello Basilica', *Arte Medievale* V (2006), 2–140.
4 As assumed by Uboldi and Verità (n. 2).
5 Henderson *et al.* (n. 1).
6 J.L. Mass, M.T. Wypyski and R.E. Stone, 'Malkata and Lisht glassmaking technologies: toward a specific link between second millennium BC metallurgists and glassmakers', *Archaeometry* 44 (2002), 67–82.
7 M.C. Calvi, M. Tornati and M.L. Scandellari, 'Ricerche tecnologiche', in M.C. Calvi (ed.), *I Vetri Romani del museo di Aquileia* (Associazione Nazionale per Aquileia), Aquileia, 1968, 195–208; R. Arletti, A. Ciarallo, S. Quartieri, G. Sabatino and G. Vezzalini, 'Archaeometrical analyses of game counters from Pompeii', in M. Maggetti and B. Messiga (eds), *Geomaterials in Cultural Heritage* (Special Publication Geological Society of London, 257), London, 2006, 175–86; R. Arletti, S. Quartieri and G. Vezzalini, 'Glass mosaic tesserae from Pompeii: an archeometrical investigation', *Periodico Mineralogia* 76 (2006), 25–38; A.J. Shortland, 'The use of antimonate colourants in Early Egyptian Glass', *Archaeometry* 44 (2002), 517–30.
8 J. Henderson, *The Science and Archaeology of Materials*, London and New York, 2000, 36 (Sn), 32 (Co).
9 M. Tite, T. Pradell and A.J. Shortland, 'Discovery, production and use of tin-based opacifiers in glasses, enamels and glazes from the Late Iron Age onwards: a reassessment', *Archaeometry* 50 (2008), 67–84.
10 W.E.S. Turner and H.P. Rooksby, 'A study of opalising agents in ancient opal glasses throughout three thousand four hundred years', *Glastechnische Berichte* 32K, VII (1959), 17–28.
11 Uboldi and Verità (n. 2); C. Fiori, M. Vandini and V. Mazzotti, *I colori del vetro antico-vetro musivo bizantino*, Padua, 2004.
12 R. Arletti, C. Fiori and M. Vandini, 'A study of glass tesserae from mosaics in the monasteries of Daphni and Hosios Loukas (Greece)', *Archaeometry* 52 (2010), 796–815.
13 C. Fiori, D. Chrysopolous, I. Karatasios and V. Lampropoulos, 'Compositional and technological characteristics of glass tesserae from the vault mosaics of Dafni Monastery, Greece', in G. Kordas (ed.), *1st International Conference Hyalos-Vitrum-Glass. History, Technology and Conservation of Glass in the Hellenic World*, Athens, 2002, 193–7.
14 P. Lazarides, *Il monastero di Dafni. Breve guida archeologica illustrata*, Athens, 1987.
15 D. Mouriki, *Stylistic Trends in Monumental Painting of Greece during the Eleventh and Twelfth Centuries*, Washington DC, 1981.
16 Lazarides (n. 14).
17 R. Cormack, *Byzantine Art*, Oxford, 1997.
18 A. Grabar, *Bisanzio. L'arte bizantina del Medioevo all'VIII al XV secolo*, Milan, 1964.
19 A. Guiglia Guidobaldi, 'I cicli musivi dell'XI secolo', in C. Barsanti, M. Dellavalle, R. Flamino, A. Guiglia Guidobaldi, P. Paribeni and S. Pasi (eds), *Lineamenti di storia dell'arte bizantina, II, dispense di storia dell'arte bizantina*, Rome, 2003.
20 J. Nesbitt and A. Cutler, *L'arte bizantina e il suo pubblico*, Turin, 1986.
21 C. Mango, *Architettura bizantina*, Milan, 1978.
22 Guiglia Guidobaldi (n. 19); M. Chatzidakis, *Hosios Loukas. Byzantine Art in Greece*, Athens, 1997; Mouriki (n. 15); N. Oikinomides, 'The first century of the Monastery of Hosios Loukas', *Dumbarton Oaks Papers* 46 (1992), 245–55.
23 T. Velmans, 'La pittura parietale e le icone', in A. Novello (ed.), *Arte bizantina in Grecia*, Milan, 1999, 176–201; Mouriki (n. 15).
24 R. Stoneman, *Grecia*, Florence, 1991.
25 Mass *et al.* (n. 6); Shortland (n. 7); A.J. Shortland, 'Comment II on J.L. Mass, M.T. Wypyski and R.E. Stone (2002) 'Malkata and Lisht glassmaking technologies: toward a specific link between second millennium BC metallurgist and glassmaker', *Archaeometry* 45/1 (2003), 185–9.
26 A. Ahmed and G.M. Ashour, 'Effect of heat treatment on the crystallization of cuprous oxide in glass', *Glass Technology* 22 (1981), 24–33; I.C. Freestone, 'Composition and microstructure of early opaque red glass', in M. Bimson and I.C. Freestone (eds), *Early Vitreous Materials* (British Museum Occasional Paper, 56), London, 1987, 173–91; R.H. Brill, 'Scientific studies of the panel materials', in L. Ibrahim, R. Scranton and R.H. Brill (eds), *Kenchreai: Eastern Port of Corinth; Results of Investigations by the University of Chicago and Indiana University for the American School of Classical Studies at Athens, vol. 2, The Panels of Opus Sectile in Glass*, Leiden, 1976, 227–55; R.H. Brill and N.D. Cahill, 'A red opaque glass from Sardis and some thoughts on red opaques in general', *Journal of Glass Studies* 30 (1988), 16–27; I.C. Freestone, M. Bimson and D. Buckton, 'Compositional categories of Byzantine glass tesserae', in *Annales du 11e Congrès de l'Association Internationale pour l'Histoire du Verre, Bâle, 29 août – 3 septembre 1988, AIHV*, Amsterdam, 1990, 271–81; N. Brun, L. Mazerolles and M. Pernot, 'Microstructure of opaque red glass containing copper', *Journal of Materials Science Letters* 10 (1991), 1418–20; I. Nakai, C. Numako, H. Hosono and K. Yamasaki, 'Origin of the red colour of Satsuma copper-ruby glass as determined by EXAFS and optical absorption spectroscopy', *Journal of the American Ceramic Society* 82 (1999), 689–95; A. Shugar, 'Byzantine opaque red glass tesserae from Beit Shean, Israel', *Archaeometry* 42 (2000), 375–84; P. Mirti, P. Davit and M. Gulmini, 'Colourants and opacifiers in seventh and eighth century glass investigated by spectroscopic techniques', *Analytical and Bioanalytical Chemistry* 372 (2002), 221–9; Arletti *et al.* (n. 7); R. Arletti, M.C. Dalconi, S. Quartieri, M. Triscari and G. Vezzalini, 'Roman coloured and opaque glass production: a XAS study', *Applied Physics A* 83 (2006), 239–46; A. Santagostino Barbone, E. Gliozzo, F. D'Acapito, I. Memmi Turbanti, M. Turchiano and G. Volpe, 'The sectilia panels of Faragola (Ascoli Satriano, Southern Italy): multi analytical study of red, orange and yellow glass slabs', *Archaeometry* 50 (2008), 451–73.
27 Higher than 2%, following: C. Lilyquist and R.H. Brill, *Studies in Ancient Egyptian Glass*, Metropolitan Museum of Art, New York, 1993.
28 Andreescu-Treadgold and Henderson (n. 3).
29 Henderson *et al.* (n. 1).
30 R.H. Brill, *Chemical Analyses of Early Glasses*, The Corning Museum of Glass, Corning, 1999.
31 Lilyquist and Brill (n. 27).
32 Arletti *et al.* (n. 12).
33 Brill (n. 30).
34 Freestone *et al.* (n. 26).
35 Andreescu-Treadgold and Henderson (n. 3).

Chapter 9
Notes on the Morphology of the Gold Glass Tesserae from Daphni Monastery

Polytimi Loukopoulou and Antonia Moropoulou

Introduction

The technique of decorating glass with gold leaf dates back to ancient times and was used extensively in the production of Byzantine gold glass tesserae. This was achieved by gold (or silver) being enclosed between two layers of usually transparent glass: the support glass and a second very thin layer, a casing called a cartellina. In order to produce the tesserae, a sandwich gold glass slab (disc) is prepared and the tesserae are cut off to the required size, usually in a square pattern. The manufacturing technique of gold glass tesserae inevitably influences its durability and necessitates a high level of expertise from the craftsman.[1] Unfortunately, few written sources survive about this process and consequently the method employed for their production in the Byzantine period has not been investigated.

Until now, the most comprehensive analysis of the gold glass tesserae from Byzantine monuments in Greece and beyond has been published by Robert Brill.[2] Moreover, Brill provides one of the earliest (according to the authors' knowledge) descriptions of gold glass tesserae from 4th-century Kenchreai, the eastern port of Corinth.[3] Whilst chemical analysis and alteration studies of glass tesserae have been carried out over the past 30 years,[4] gold glass tesserae have not received the same degree of attention.[5] However, both the manufacturing and production techniques of gold glass tesserae have been discussed in publications concerning mosaic glass.[6] Further, following the examination of the borders of the gold glass slab from Aquileia, Italy, Marco Verità gave a possible explanation for the manufacturing technique of gold glass tesserae.[7]

The aim of this work, however, is to present the results of a systematic examination of the morphology of Byzantine gold glass tesserae dating to the 11th century. The physical characteristics of the tesserae will be reviewed and technological evidence will be discussed in conjunction with current practice and the knowledge of the manufacturing techniques of gold glass tesserae in medieval times.

Methodology

A survey of gold glass tesserae was carried out *in situ* and on detached material at the 11th-century Byzantine monastery of Daphni near Athens, followed by a more systematic macroscopic and microscopic examination of over 200 tesserae. Detached tesserae facilitated a detailed examination of all sides of the object. Included among the examined materials were a large number of tesserae from the border (edge) of the sandwich gold glass slab. The examination of these tesserae (later referred to as edges) revealed details of the sandwich gold glass slab micro-morphology.

Photographic documentation was carried out using a digital camera (OLYMPUS, SP-560UZ) and a digital portable microscope (Dino-Lite, AM211, Adjustable focus & Magnification ×10 ~ ×200). Tesserae dimensions and the thickness of the two glass layers were measured with the portable digital microscope. The accuracy of the Dino-Lite measurements (approximately 2% error) was estimated using an Olympus stage micrometer for optical microscopy (Olympus Objective Micrometer, AX0001, OB-M, 1/100).

Results

Gold glass tesserae can be defined in terms of the physical characteristics of the two glass layers (cartellina and the support) and the nature of the gold leaf. Furthermore, the edges could be classified by the form of the support glass (which forms the border of the slab) and the shape of the end point of the cartellina.

Both the cartellina and the support were made of transparent glass. The cartellina usually had a light tint, while the support glass exhibited a stronger colouration. Very often the colour of the glass was not uniform, a feature initially observed for purple tesserae.[8] In addition, arriving at an accurate colour description for the cartellina layer proved to be a challenging issue. The cartellina's thickness and hue, the colour of the support glass, the presence and the nature of the gold leaf and even the angle of view influenced its colour. A more accurate colour definition was obtained mainly for the edges where usually an excess of the cartellina layer could be examined. In many cases cartellina appeared to be made of an aqua glass, followed by a nearly colourless (with a light aqua or purple hue) and a roughly amber glass.

The majority of the tesserae were approximately square or rectangular in shape (cubes or parallelepipeds). The average size of the tesserae side ranged from between 7 to 9mm whereas their height was usually smaller, around 6mm, even 4mm for a particular group. The cartellina has been reported to be less than 1mm thick.[9] The average thickness measured on the Daphni tesserae was quite small, ranging from around 0.2 to 0.3mm. The cartellina thickness was fairly uniform and only in a few cases was a difference on the same tesserae visually detected. An attempt to correlate thickness with other physical characteristics of the tesserae was carried out; however, the results were inconclusive and further analysis was outside the scope of this paper.

All the edges exhibited a deformed cubical form as one side of the support glass was rounded. In some cases the shape of these tesserae was more triangular than square, like the sector of a circle (**Pl. 1**). Assuming that the original glass slab had an elliptical shape, an attempt was made to estimate the diameter of its ending by calculating the radius from these sectors. The diameter of the slab when estimated in this way was around 20mm. Moreover, in a few edges the support was made by two joined pieces of glass.

Plate 1 Reverse of a triangular-shaped edge (digital microscope, bar measured 1mm, magnification 50×)

Plate 2 Wavy marks on the reverse of a tessera (digital microscope, bar measured 1mm, magnification 50×)

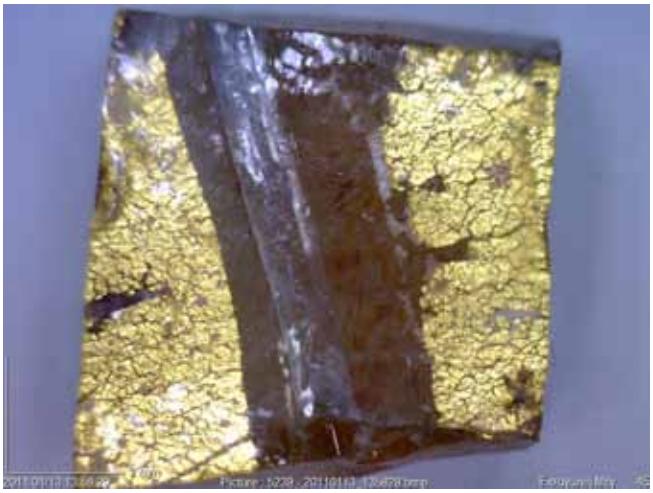


Plate 3 Linear mark created by a tubular void in the cartellina, a feature detectable due to a large break of the gold leaf (digital microscope, bar measured 2mm, magnification 45×)

The presence of flow lines (striations/streaks) on the support glass was observed, occasionally exhibiting a zigzag shape (usually near the rounded side of the edge). The reverse of the tesserae had an uneven surface with a variable degree of roughness. The surface usually presented marks of a granular material (**Pl. 1**); moreover, on many tesserae wavy marks like grains of wood were observed (**Pl. 2**).

Surface imperfections, initially attributed to the gold, were often due to defects of the cartellina, for example a linear mark across the surface was created by a discontinuity of the cartellina layer leaving a narrow band of uncovered gold leaf. Moreover, a ripple mark or a wavy line on the surface was caused by an increase in the height or the depth of the cartellina's layer – a deeper layer was due to an unevenness of the supporting glass surface. Occasionally, a tubular void resembling an elongated and flattened air bubble (of large cross-section) was detected in the cartellina (**Pl. 3**).

Cartellini usually overlaid the border of the slab, in some cases almost enclosing the support glass. The two glass layers

Plate 4 Cartellina exhibiting a bulbous end point with a U-shaped tip (digital microscope, bar measured 1mm, magnification 50×)

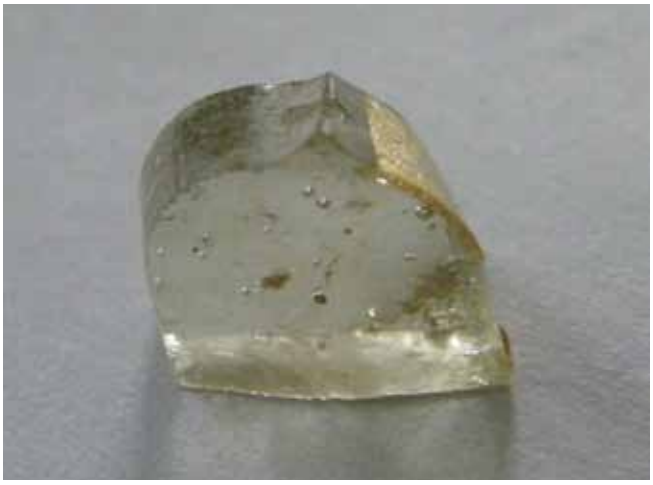


Plate 5 Cartellina with a conical-shaped tip. Edge dimensions 7.8 × 5.6 × 8.6cm (digital camera, macro-photograph)

were not at all times perfectly attached and the shape of the cartellina's end point was not always detectable due to fracture.

A common shape of the cartellina's end point was that of a bulbous tip exhibiting the profile of a droplet. In some cases this end point had the profile of a droplet on one side of the edge and a more flattened form on the other side. Due to variations in the layer's extent, the bulbous end point was detected in different positions: on the top surface of the edge, on the edge of its rounded side or overlying the rounded side. Occasionally, the cartellina fell over the rounded side and then rose again creating a U-shaped tip (**Pl. 4**). Moreover, on some edges where the cartellina finished on the upper surface, a slight swelling of the support glass next to the bulbous tip was observed. A similar effect previously recorded was interpreted as evidence of distortion due to pressure.[10] A different type of the bulbous end point had a conical-shaped tip that could easily be misinterpreted as broken (**Pl. 5**).

On some edges the cartellina showed a folded finish. The layer was folded back either on the rounded side or at the base of the tessera while in some cases a double folding was also detected (**Pl. 6**). The cartellina usually exhibited near the border an uneven surface due to the presence of further wrinkles. However, wrinkles, folds or blisters were also detected on the surface of edges that did not have a folded cartellina finish. In contrast, the wavy surface detected on two tesserae was created by an undulated cartellina well fixed on the support. A limited number of tesserae exhibited a cartellina's finish perfectly attached on the support glass, sometimes even embedded in it (**Pl. 7**). In this case the cartellina did not stand out as a separate layer and a perfectly levelled surface was observed. Of particular interest was the end point detected on a very few tesserae, which appeared to be fire finished (**Pl. 8**).

Although a large number of edges have been examined, only a few gave indications of the shape of the cartellina's border. Occasionally, a curved contour was observed (**Pl. 9**); however, an irregular-shaped border was more common particularly on edges where the cartellina enclosed most of the support glass.

Gold leaf exhibited a micro-fissured surface or a surface with a network of more open cracks. Moreover, on many tesserae larger breaks of the gold leaf were observed as well as creases and rips on its surface. Sometimes the breaks were quite wide and the borders of the gold leaf were too straight to indicate damage (**Pl. 3**). Therefore, these openings were probably the gap between two different pieces of gold leaf.

Plate 6 Cartellina folded back on the rounded side (in this case a double folding can be observed) (digital microscope, bar measured 1mm, magnification 60×)

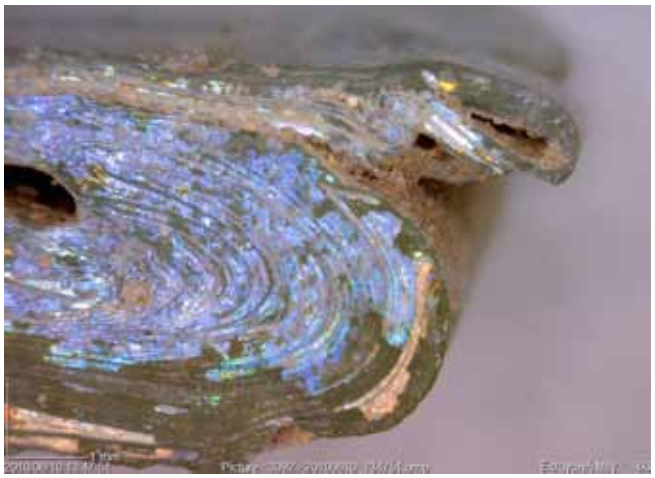


Plate 7 Cartellina perfectly attached to the support glass (digital microscope, bar measured 1mm, magnification 50×)

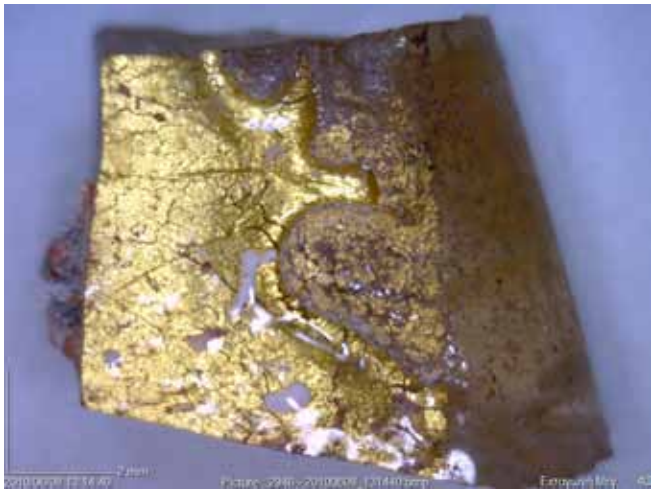


Plate 8 Cartellina exhibiting a fire-finished end point (digital microscope, bar measured 2mm, magnification 40×)

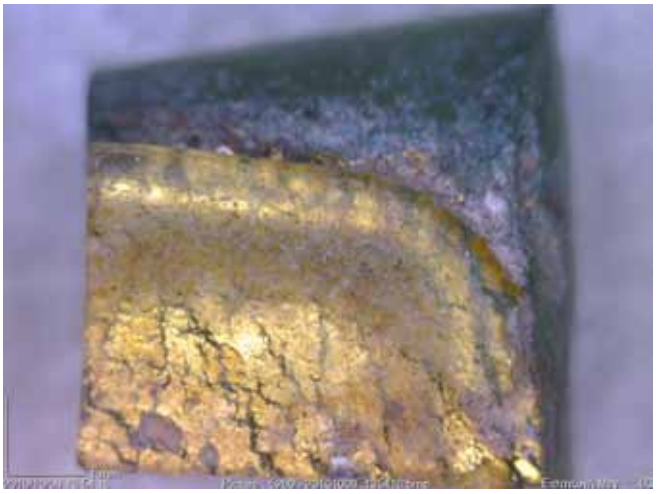


Plate 9 A curved contour of the cartellina (digital microscope, bar measured 1mm, magnification 60×)

The gold leaf appears to be very thin as indicated by its high transparency when tesserae were viewed in transmitted light. The consistent finding of a straight border of the gold leaf, and the occasional presence of corners exhibiting a right or obtuse angle, demonstrated the use of a parallelogram leaf (square, rectangular or trapezium). Furthermore, the presence of additional patches of gold leaf was detected. In most cases the shape of the additional piece appeared to be rectangular.

On many edges the cartellina did not enclose completely the gold leaf while on a number of tesserae the gold leaf did not entirely cover the support glass. In addition, a small group of edges with a large hole at the extremes of the support glass was detected (**Pl. 10**). The hole usually had the shape of a bowed drop resembling a crescent and occupied approximately two thirds of the total tessera thickness.

Discussion

According to previous publications, the metal leaf was attached either to the support glass[11] or to the cartellina.[12] The second layer was applied and after heating the whole structure was pressed in order to achieve a good adhesion of the three layers. The cartellina was supposedly made of blown or ground glass and the support of cast glass. Marco Verità suggested the use of a fragment of thin blown glass possibly cut to the same size as the gold leaf – presumably in a square shape.[13] According to his proposed explanation for the manufacturing technique, the cartellina, with the attached gold leaf facing up, was placed on a metal support and heated in the furnace.[14] After heating, cast glass was poured on top and the structure was immediately reversed and placed on a layer of pulverized clay. While still in a plastic state the cartellina was pressed on the support, possibly with an appropriate metal tool.

Knowledge of medieval glassmaking, among other crafts, derives from the work of the German monk Theophilus, *De Diversis Artibus*, dated to the early 12th century. In his second book, *The Art of the Worker in Glass*,[15] Theophilus describes the production of Byzantine glass for mosaics and although the technique he describes is unlikely to be accurate, he does mention that the square pieces (tesserae), covered with gold leaf and coated with ground glass, were laid on an iron plate covered with lime or ashes and fired. Moreover, in the same book, when referring to the firing of painted glass pieces, he again describes the use of iron plates filled in with dry quicklime or ashes and levelled with a smooth flat piece of wood.[16] The presence of flow lines in the Daphni tesserae confirmed the use of cast glass. However, as the support glass exhibited an uneven reverse, it is most likely that the glass was not freely poured onto a flat surface but onto a surface or a shallow tray covered with a pulverized material. In addition, the wavy marks detected on the reverses of the tesserae resembled traces of a powdered material flattened with a piece of wood or supported by wood.

The use of ground glass for cartellini mentioned by Theophilus and reported by previous workers[17] has been rejected on the evidence of its homogeneity.[18] However, Giorgio Vasari, in the 16th century, also described the use of a glass piece (broken glass bottles) large enough to cover the entire disc.[19]

Today, in one of the few factories still producing sandwich gold glass tesserae,[20] the slab is prepared in three main stages: the production of the cartellina (very thin blown glass is prepared and then cut in small square pieces), the attachment of a square gold leaf on the cartellina and finally the production of the sandwich gold glass structure – the

Plate 10 Edge exhibiting a crescent-shaped hole in the support glass (digital microscope, bar measured 2mm, magnification 45×)

slab. The cartellina is heated, a quantity of cast glass is poured on top and the sandwich structure is heated and pressed on a flat surface. Finally, the small discs (slabs) once created are then reversed and annealed. The sandwich gold glass slab produced is oval, almost 180mm by 135mm in length and 4mm thick.

Although modern slabs are approximately elliptical, finds from earlier centuries (for example San Marco in Venice) attest the use of a more elongated shape called 'lingua' (tongue).[21] The approximate diameter of the border of the slab, calculated from the Daphni edges, was very small. This probably indicates a more elongated shape, perhaps like a stripe. Furthermore, it is not possible to produce a triangular-shaped tessera approximately 8mm in size simply by chopping a piece of glass from the border of an elliptical slab of this size.

On the modern slab the square gold leaf and the cartellina are situated at the centre of its approximately elliptical shape. The gold leaf has mainly fine creases and occasionally micro-fissures. The cartellina rarely covers the border of the support glass and is firmly attached onto it. The perimeter of both layers is straight as they are pre-cut in a square pattern. The cartellina is partly embedded in the support glass as a result of pressing and its interface with the support glass is like a fine crack or a narrow groove. The reverse is flat and the border of the slab is smoothly rounded. The tesserae are created by cutting pieces of glass only from the central area of the disc.

In contrast, during the 11th century an entire gold glass slab was used to create the tesserae. The back and occasionally the upper surface of the support glass were uneven and the border of the slab was not always perfectly rounded. The cartellina regularly enclosed at least part of the support's rounded side. The gold leaf either reached the border of the slab as shown by the corners discovered on edges or finished away from it, as indicated by tesserae incompletely covered with gold. Moreover, it was rare for the cartellina to be totally embedded in the support glass and the gold exhibited a network of fissures or larger cracks. The piece of gold leaf was probably a parallelogram in shape and quite small as more than one was used. Based on the above observations, the size and perhaps the shape of the cartellina and the gold leaf was probably different.

The application of cast glass on top of a cut piece of blown glass (cartellina) and the overturning of the structure while still in a plastic state could not have resulted in such an excess of the glass layer, encasing part of the support and exhibiting end points like the bulbous type. On the contrary, an irregular shaped piece of glass could have been produced after heating a thin layer on the top surface of the slab that freely drips on its sides. Moreover, the folded end point of the cartellina and the occurrence of wrinkles and blisters on the surface of the tesserae may possibly indicate that during the 11th century the practice was to apply the cartellina on the support glass and not the other way round. It is also interesting to note that although Theophilus and Vasari reported the use of different types of glass, they both mentioned the application of cartellina on top of the support glass.

The bulbous end point of the cartellina implies a flowing of the glass as a result of heating when, according to Rosemarie Lierke, 'everything becomes round in the fire'.[22] However, the U-shaped tip, the conical tip and the folded back end point showed shaping of the glass during or after its application. Moreover, the wavy surface of some tesserae and the occasional swelling of the support glass near the border perhaps indicate that pressure was applied.

Conclusion

The study of the physical characteristics of glass objects aims to determine their method of manufacture, which is one of the principal means for their classification.[23] The examination of gold glass tesserae morphology from the Byzantine monastery of Daphni revealed evidence that could relate to the manufacturing technique.

Signs of pouring the glass onto a rough and perhaps levelled surface during preparation of the glass slab were discovered. The possibility of the finished glass slab having the shape of a 'tongue' was shown by calculations, while the shape of the gold leaf has been recognized as a parallelogram. The physical characteristics of the tesserae provided contradictory evidence of the cartellina's shaping technique, which consequently raised the question of the possible use of different working methods. The current manufacturing technique of the gold glass slab results in a final product quite different to the 'picture' of the slab revealed by the examination of the edges. As a result it was suggested that perhaps in this period the practice was to apply the cartellina on the support glass and not the other way round.

This work intends to contribute to the investigation of the manufacturing technique of the Byzantine gold glass slab by studying the morphology of the tesserae. However, the interpretation of the evidence can be highly subjective so further research and discussion is required.

Acknowledgements

Our thanks go to Nikolaos Minos director of the Directorate of Conservation of Ancient and Modern Monuments (Hellenic Ministry of Culture and Tourism) for facilitating research; the conservation team at Daphni Monastery for their assistance and interest during the *in situ* examination; and finally, to Angelo Orsoni srl for permission to visit the factory during the production of gold glass slab and for providing samples of modern gold glass tesserae and gold glass slab.

Notes

1 M. Verità, 'Glass mosaic and smalti: technique, materials, decay and conservation', in C. Moldi Ravenna (ed.), *I colori della luce: Angelo Orsoni e l'arte del mosaico*, Venice, 1996, 41–97; M. Verità, 'Technology and deterioration of vitreous mosaic tesserae', *Reviews in Conservation* 1 (2000), 65–76.

2 R.H. Brill, *Chemical Analyses of Early Glasses*, vols I and II, Corning Museum of Glass, New York, 1999.

3 Ibid., vol. I, 291.

4 I.C. Freestone, M. Bimson and D. Buckton, 'Compositional categories of Byzantine glass tesserae', *Annales du 11th Congrès de l'Association Internationale pour l'Histoire du Verre: Basel 29 August–3 September 1988. Amsterdam (AIHV)*, Amsterdam, 1990, 271–9; M. Verità, 'Analisi delle tessere musive', in V. Tiberia (ed.), *Il restauro del mosaico della Basilica sei Santi Cosma e Damiano a Roma* (Arte e Restauro 7), Perugia, 1991, 75–9; A. Ruffini, C. Fiori and M. Vandini, 'Caratterizzazione chimica di vetri musivi antichi. Parte

1: metodologie d'analisi e risultati', *Ceramurgia* 29(4) (1999), 285–98; A. Ruffini, C. Fiori and M. Vandini, 'Caratterizzazione chimica di vetri musivi antichi. Parte 2: elaborazione dei dati analitici', *Ceramurgia* 29 (5–6) (1999), 361–8; P. Costagliola, G. Baldi, C. Cipriani, E. Pecchioni and A. Buccianti, 'Mineralogical and chemical characterisation of Medican glass mosaic tesserae and mortars from the Grotta del Buontalenti, Giardino di Boboli, Florence, Italy', *Journal of Cultural Heritage* 1 (2000), 287–99; A. N. Shugar, 'Byzantine opaque red glass tesserae from Beit Shean, Israel', *Archaeometry* 42/2 (2000), 375–84; M. Verità, R. Falcone, M. Valloto and P. Santopadre, 'Study of the weathering mechanisms and chemical composition of ancient mosaic tesserae', *Rivista della stazione sperimentale del vetro* 6 (2000), 33–44; C. Fiori, L. Alberti, A. Albertazzi, E. Rastelli and M. Vandini, 'Studio della composizione e del degrado delle tessere vetrose del mosaico 'Madonna con bambino' del Quirinale (Roma)', in *I Mosaici Cultura, Tecnologia, Conservazione, Atti del Convegno di Studi Bressanone 2–5 luglio 2002, Scienza e Beni Culturali XVIII*, Venice, 2002, 563–72; C. Fiori, D. Chrysopoulos, I. Karatasios and V. Lampropoulos, 'Compositional and technological categories of glass tesserae from the vault mosaics of Dafni monastery, Greece', in G. Kordas (ed.), *1st International Conference: Hyalos – Vitrum – Glass: History, Technology and Conservation of Glass and Vitreous Materials in the Hellenic World, Rhodes 1–4 April 2001*, Athens, 2002, 193–7; M. Verità, A. Renier and S. Zecchin, 'Chemical analysis of ancient glass findings excavated in the Venetian lagoon', *Journal of Cultural Heritage* 3 (2002), 261–71; M. Verità, B. Profito and M. Valloto, 'I Mosaici della Basilica dei Santi Cosma e Damiano a Roma: studio analitico delle tessere vitree', *Rivista della stazione sperimentale del vetro* 5 (2002), 13–23; F. Branda, G. Luciani, A. Costantini, G. Laudisio and M. Vandini, 'Chemical composition, thermal properties and weathering of a Roman azur tessera from the Ninfeo of Punta Epitaffio in Baia', *Glass Technology* 43/3 (2002), 125–30; C. Fiori, M. Vandini and R. Arletti, 'Smalti musivi dei monasteri greci di Dafni e Hosios Loukas', *Ceramurgia + Ceramica Acta*, XXXVII(2) (2007), 103–16; M. Verità and P. Santopadre, 'Analysis of gold-colored ruby glass tesserae in Roman church mosaics of the fourth to twelfth centuries', *Journal of Glass Studies* 52 (2010), 11–24.

5 C. Fiori, F. Donati, I. Fiorentini-Roncuzzi and R. Farioli-Campanati, 'Analisi e confronto di tessere vetrose dorate di mosaici Bizantini del VI secolo', in C. Fiori and I. Fiorentini Roncuzzi (eds), *Mosaico e Restauro Musivo*, vol. II (C.N.R –Instituto di Ricerche Tecnologiche per la Ceramica), Ravenna, 1989, 17–30; E. Carbonara, C. Muscolino and G. Tedeschi, 'La luce nel mosaico: le tessere d'oro di Ravenna. Tecniche di fabbricazione e utilizzo', in F. Guidobaldi and A. Paribeni (eds), *Atti del VI Colloquio dell' Associazione del Mosaico, AISCOM*, Girasole, 2000, 709–18; Verità *et al.* 2000 (n. 4); A. Moropoulou, N.P. Avdelidis, E.T. Delegou, C. Gill and J. Smith, 'Study of deterioration mechanisms of vitreous tesserae mosaics', *Scienza e Beni Culturali* XVIII (2002), 843–51; M. Verità, 'Tessere vitree a foglia d'oro nei mosaici di Aquileia', *Quaderni Friulani di Archeologia* XVI (2006), 7–12; Verità and Santopadre (n. 4).

6 Verità 1996 (n. 1); Verità 2000 (n. 1); L. James, 'Byzantine glass mosaic tesserae: some material considerations', *Byzantine and Modern Greek Studies* 30/1 (2006), 29–47.

7 Verità (n. 5).

8 P. Loukopoulou and A. Moropoulou, 'A study of Byzantine gold glass tesserae', *5th Symposium of the Hellenic Society of Archaeometry, 8–10 October 2008*, Athens, 2012, 565–74; P. Loukopoulou and A. Moropoulou, 'Byzantine gold-leaf glass tesserae: a closer look at manufacturing technique and decay (Poster presentation)', *18th Congress of the Association Internationale pour l'Histoire du Verre, Thessaloniki, 21–5 September 2009*, Thessaloniki, 2012, 307–8.

9 Fiori *et al.* (n. 5); Verità 1996 (n. 1).

10 Verità (n. 5), 9.

11 Fiori *et al.* (n. 5); Verità 1996 (n. 1); Verità 2000 (n. 1).

12 Verità 1996 (n. 1); Verità 2000 (n. 1).

13 Verità (n. 5), 9.

14 Ibid., 11–12.

15 J. Hawthorne and C. Smith, *On Divers Arts: The Treatise of Theophilus*, New York, 1963, 60–1.

16 Ibid., 66.

17 G. Bustacchini, 'Gold in mosaic art and technique', *Gold Bulletin* 6/2 (1973), 52–6; Fiori *et al.* (n. 5).

18 Verità 1996 (n. 1).

19 L.S. Maclehose (trans.), *Vasari on Technique – Georgio Vasari*, London, 1907, 254–5.

20 Angelo Orsoni srl ('ORSONI, Smalti Veneziani'), a factory in Venice, Italy, which produces glass tesserae.

21 Glossary of mosaic terms [PDF], 'The composition of Byzantine glass mosaic tesserae, international network sponsored by The Leverhulme Trust 2007–10, http://www.sussex.ac.uk/arthistory/research/byzantine/mosaictesserae/publications.

22 R. Lierke, *Die nicht-geblasenen antiken Glasgefäbe, The Non-Blown Ancient Glass Vessels*, Offenbach/Mainz, 2009, 93.

23 L. Pilosi and M. Wypyski, 'The weathering of ancient cold worked glass surfaces', in Kordas (n. 4), 101–7, esp. 101.

Chapter 10
Glass Producers in Late Antique and Byzantine Texts and Papyri

E. Marianne Stern

Current studies on ancient glass concentrate largely on the objects themselves: they centre on typology, archaeological context and archaeometrical analysis. In addition, Rosemarie Lierke has made important contributions to our understanding of ancient production techniques.[1] However, the written evidence concerning ancient glass producers and glass production, a type of evidence that dominated research until the early 20th century, appears to have fallen out of favour. Modern researchers cite ancient texts occasionally, but usually for no more reason than to illustrate conclusions reached by other means. Ancient texts are rarely taken seriously if they are not confirmed by object-centred research, let alone if they appear to contradict the results of such research.

In my opinion it is time to rehabilitate the study of texts as a valid resource. On the one hand, we need to re-interpret familiar literary and semi-literary texts in the light of novel insights into the ancient glass industry, such as Petronius, *Satyricon* 51, Pliny, *Natural History* 36.193 and Strabo *Geographica* 16.2.25.[2] On the other hand, we need to make use of lesser-known authors and especially of the steadily increasing number of inscriptions and papyri becoming available through publications and electronic databases. The purpose of this paper is to present the preliminary results of my philological research on ancient glass producers and to discuss some of the information that can be gleaned from these sources. It is a work in progress and should be regarded as such.

Scope of investigation and introductory remarks

In this paper I concentrate on two categories of evidence written in Greek: documentary papyri and literary or semi-literary texts. The papyri mentioning glass producers come from Egypt and date from the 1st century BC to the 8th century AD. The documentary papyri are important, because the information they provide is not derivative as in literary and semi-literary texts. Comparable to archaeological evidence from controlled excavations, documentary papyri are direct evidence for situations existing at the time when they were written. The contents range from simple lists of names followed by a profession to contracts between city authorities and individual craftsmen or guilds, invoices, law suits, tax lists, lists of private expenses, and even an acrostic with the Greek word for glassworker representing the letter y, lowercase Greek 'ypsilon', transliterated as 'u'.[3]

The literary texts reviewed in this paper date from the 4th to the 12th century, although the events they record can be of an earlier date. The authors were historians, philosophers and clerics. Their primary interest was historical or philosophical and subjects include bible interpretations, conversion to Christianity and miracles. Several alchemical texts are associated with scholars active in Egypt, but most of the other authors lived in Constantinople, Asia Minor or Syria.

The authors consulted for this paper were: Didymus Caecus, who wrote a commentary on the psalms in the 4th century; Agathangelos, who translated a history of Armenia from Armenian into Greek in the 5th century; Evagrios, a cleric writing in the 6th century; John of Alexandria, a

medical doctor who lectured on Hippocrates in the 6th century; John Moschos' *Pratum spirituale* (6th to early 7th century); Bishop Leontios' report on the life of Symeon Salos (Leontios *fl. c.* 615); George the Monk (9th century); *The Life and Miracles of Saint Photeine* by an anonymous author of the 10th century,[4] and the historians Kedrenos (11th century) and Glykas (12th century).

My research focuses on compounds in which the Greek word for glass ὕαλος (*hualos*) is combined with a suffix indicating a glass producer.[5] I have discussed the meaning of Greek nouns, adjectives and verbs containing these elements elsewhere.[6] This paper is concerned with the artisans themselves, in other words, the people who actually made the glass or turned it into objects.

Archaeological and archeometrical research has established beyond doubt that up until the Middle Ages, ancient glass production was divided into two separate branches, one for making raw glass from primary ingredients, the other for working the material and shaping glass objects.[7] In glass research it has become customary to refer to the production of the material itself as primary glassmaking. Installations for primary production existed in just a few regions, amongst others in Egypt and along the Syro-Palestinian coast, from where chunks of raw glass were shipped all over the ancient world to be remelted and turned into objects in secondary workshops. The division of the ancient glass industry into primary and secondary workshops had important consequences for the structure of the industry.[8] It is not clear to what extent this division affected the original choice of the suffixes encountered in the Greek compounds denoting glass producers.

Pseudo-Elias 15.8 (7th to early 8th century) explains the etymology of 'banausic' (*cf.* German *banausisch*, 'commonplace, vulgar') as deriving from *bainein* 'to advance' and *ausos* 'fire': 'βάναυσοι δέ εἰσι τέχναι ὅσαι παρὰ τὸν αὖσον βαίνουσιν – αὖσος δέ ἐστι τὸ πῦρ – οἷον χαλκευτικὴ καὶ ὑαλουργική· νῦν δὲ καταχρηστικῶς καὶ αἱ λοιπαὶ τέχναι βάναυσοι λέγονται' (The banausic arts are those that advance through *ausos* – *ausos* is fire – such as metalworking (*khalkeutikê*) and glassworking (*hualourgikê*). Now, all the other crafts are incorrectly called banausic).[9] The production of raw glass required several stages of heating the ingredients at different temperatures, but it always involved melting the ingredients entirely at a certain point: *kheisthai* 'to be made fluid' (Strabo 16.2.25). The raw glass was reheated in secondary workshops; originally, it was usually not entirely remelted. Vessels and other objects could be shaped at lower temperatures because glass softens gradually. However, during the course of the 1st century it became common practice for most glassworkers to remelt the raw glass and work with molten glass.[10]

The Greek words for glass producers

Two groups of compounds formed with *hualos* indicate glass producers.[11] In the first group, the second half of the compound is derived from the root *erg (originally *werg and related to English 'work'). Compounds made with *erg were common for indicating the métier of a craftsman working with a specific material. One of the earliest occurrences is *kuanourgos* (a craftsman working with *kuanos*, blue glass and/or lapis lazuli), known from Mycenaean documents of the 2nd millennium BC.[12] A *hualourgos* was literally a glassworker. The word is documented in papyri and literary texts (e.g. Strabo 16.2.25) from the 1st century BC onwards. It remained the most frequently used appellation for glassworker throughout the Byzantine period. The compounds based on the root *erg, had a broad meaning and applied to all types of secondary glassworking.[13]

The second group combines *hualos* with a suffix derived from the verb ἕψειν (*hepsein*), 'to boil, cook, smelt'. The *hualepsos* was literally a glass (s)melter. The compounds belonging to this group are encountered regularly from the 5th century onwards. They appear to have had a more restricted meaning, closely associated with heat and smelting.[14] The entry for *huelepsês* in Hesychios' lexicon (5th century) is incomplete.[15] Definitions of a later date are more concerned with defining *hualopsikê tekhnê* as the craft associated with the material glass than with the question of how and by which means the glass is worked.[16] It is tempting to assume that the authors meant glassblowing by the term *hualopsikê tekhnê*, but we can't say for sure. However, several literary texts dated to the 6th century and later refer to artisans called *hualepsos* (or a similar term) who can only have been glassblowers. To the examples cited in a previous article[17] one may add John of Alexandria, a 6th-century commentator on Hippocrates, who compares the development of an embryo with the art of the *hualôps* blowing a glass vessel: 'for the *hualôps* creates at the same time a passage and a shape while he blows'.[18] Olympiodoros (6th century) notes that *huelepseis* (glassblowers?) are apprehensive of salamanders because they are not only incapable of being burnt, but they might actually extinguish the fire in their furnace.[19]

A caveat is needed here. *Hualepsos* and the other compounds formed with *hepsein* cannot always be interpreted as evidence for working with molten glass, let alone for glassblowing! Just like many people today apply the term 'glassblower' to all kinds of artists and artisans working with glass, ancient authors, too, occasionally used the word *hualepsos* loosely to indicate any craftsperson working with glass. For example, an anonymous commentary of the 5th century or later on Lucian, *Lexiphanes* 7,[20] explains the word *mentorourgês* as a specific shape of cup 'made by a *hualopsos* named Mentor'. Even if the commentator knew that Mentor was a Greek glassworker who probably lived in the 5th or 4th century BC,[21] he certainly did not realize that Mentor wouldn't have blown the cups. (The artist lived long before the invention of glassblowing in the 1st century BC.)

Although *hualepsos* soon became a common designation for glassblower (see below), the word appears to have been associated originally with primary glassmaking. This is evident in the earliest instance known to me of any compound made with a suffix derived from *hepsein* in a 4th-century commentary on Psalm 44:

> sand and natron look like glass when they have been prepared (*skeuasthenta*) by the glassmaker (*huelepsos*). I don't say that the sand has disappeared entirely or the natron, but that they have become glass. As proof that this is an alteration, listen. When the natron was still natron, it dissolved when it came into contact with a fluid, but the glass that came into being out of it

> [the natron] is not soluble. Then again, sand is dispersed when it touches a fluid. But it is not dispersed when it has become glass.[22]

A dubious substantive *huelinopoios* is formed with a suffix derived from the verb ποιεῖν (*poiein*), 'to make, produce' as of objects and works of art.[23] This compound differs from the others in that it is formed from an adjective *hualinos* (also spelled *huelinos*) meaning 'made of glass'. The *huelinopoios* is thought to have been an artisan who produced glass drinking vessels.[24] From a linguistic point of view, *hualina* need not have been restricted to drinking vessels, *hualina* could have been anything made of glass: tableware, containers, window panes, beads, ornaments and so forth. The problem with *huelinopoios* is not its meaning, but the fact that it seems to be based on an erroneous reading of an inscription found at Sparta.[25] The inscription is written in capital letters and the first letter of line 24 is a Ψ (the Greek letter psi). It has been described as 'very distinctive' from the beginning.[26] Welcker corrected the Ψ to a Y (the Greek letter ypsilon) and created the compound *huelinopoios*, which does not occur anywhere else.[27] The generally accepted reading of the inscription (1st century BC) is *psilinopoios*, maker of a special type of wreaths: the craftsman in question would have provided wreaths for the participants in a sacrifice.[28]

Almost all the references to glass producers in papyri are compounds of the type made with *erg, 'work'. The historical development of these compounds suggests that the artisans described as *huelourgoi* were involved in secondary glass production.[29] They would have produced anything from beads, ornaments, inlays and vessels (blown or made by other techniques) to architectural glass such as window glass, mosaic cubes or even glass *opus sectile* panels like those excavated at Corinth, dated *c.* AD 300,[30] and at Kenchreai, dated *c.* AD 370.[31] The output of architectural glass became increasingly important after secondary workshops began to work with molten glass in the 1st century.[32]

It is less easy to identify the meaning of *hualepsos* in the papyri (*PBad* IV, no. 97; *PSijp*, no. 36). Compounds belonging to this group are rare in documentary papyri mentioning glass producers, because the majority date from the 4th century or earlier. Based on the evidence extracted from the literary texts mentioned above, the few artisans described as *hualepsos* in documentary papyri could, in theory, have been either secondary or primary glassmakers.

With these caveats in mind, I summarize the first results of my research. To begin with, we can add a number of sites where glassworkers are attested to those known from excavations.

Sites associated with glass production (in alphabetical order)

- Alexandria: the author John Moschos (6th century) met a *huelopsos* in Alexandria who said he became blind because of an accident at work.[33] In this case the artisan could have been either a primary glassmaker or a secondary producer. Both professions would have provided ample opportunity for an eye injury. Moreover, installations for primary glass production excavated in the vicinity of Alexandria date from the time of the encounter.[34]
- Antinoöpolis: a 4th-century tax list mentions groups of persons belonging to various professions, including artisans called *huelourgoi (PUG* I, no. 24).
- Arsinoitis: a *hualepsos* is mentioned in a papyrus dated *c.* AD 650–700, but no other information is preserved (*PSijp*, no. 36). The artisan could have been either a glassblower or a primary glassmaker. The geology of the area would have been suitable for primary production.[35]
- Hermoupolis: a papyrus dated to the end of the 5th century mentions a secondary glassworker called a *huelourgos* (*BGU* 19, no. 2839); no indication of the type of wares produced.
- Lykopolis: a papyrus dated AD 287 or later mentions a secondary glass worker called *huelourgos* (*PSijp*, no. 17). There is no indication of the type of wares produced.
- Oxyrhynchos: a guild (*koinon*) of *huelourgoi* features in at least three 4th-century papyri from Oxyrhynchus. Two are contracts for window glass (*POxy* 45, no. 3265; *POxy* 54, no. 3742),[36] and one is almost certainly about window glass, since the craftsmen appear in a report of representatives of building trades (*POxy* 64, no. 4441, col. ix). The fourth papyrus does not specify what the glassworkers made (*POxy* 48, no. 3428).
- Internal evidence suggests a list of private expenses mentioning a *hualopsas* originating from Oxyrhynchus or the Oxyrhynchitis (*PBad* 97, line 35). The papyrus dates from the mid-7th to 8th century. There is no indication of the service or products provided by the *hualopsas*. The fact that the entry stands between birthday presents for a certain Patricia and quails for a festive dinner party does not necessarily mean that these items were related to each other, because each line records a separate expenditure. The amounts of the payments are not preserved. (My thanks are due to K.A. Worp for help with interpreting this papyrus and drawing my attention to the erroneous reading in line 35 of the original publication.) Worp's corrected reading does not change the meaning, but it does add an as yet unrecorded noun *hualopsas* to the constantly growing group of nouns ending in *-as* indicating a person's profession.[37] One may compare *huelinas*[38] in a list of professions dating to the 4th to 5th century where each entry is followed by the same amount: one *litra* (pound),[39] presumably one pound of metal (silver) or some other commodity substituting for money to be paid by each craftsman.[40] Unlike *hualopsas*, *huelinas* is not a compound. It is derived from the adjective *huelinos* 'of glass' (see above, discussion of *huelinopoios*). Its meaning is less specific than *hualopsas*. A *huelinas* could be any person (artisan, shopkeeper or merchant) earning a living with household wares or other products made of glass.
- Panopolis: large quantities of window glass were being made for public buildings at a town identified as Panopolis by Skeat,[41] who has convincingly revised the 4th-century date suggested in the original publication (*PGot*, no. 7) to the mid-3rd century.
- Additional evidence for the activity of glassworkers in Egypt is provided by a papyrus from an unknown site (*PRyl* 2, no. 374). It is a tax list of the late 1st century BC or early 1st century AD mentioning craftsmen who were

probably involved in secondary production, since they are called *huel{l}ourgoi*.

Several literary texts provide information on the Byzantine Empire:

- Constantinople is known for blown wares. A gruesome miracle associated with Menas, patriarch of Constantinople in the mid-6th century, concerned a Jewish glassblower whose son survived the flames in his father's furnace. Numerous accounts exist. The artisan's profession is given in early versions as *huelourgos* (variant spellings);[42] later authors call the artisan a *huelopsos*.[43] In the 10th century, a fire that started in a glass workshop, an *ergastêrion huelopsêtikon*, destroyed a large part of the centre of Constantinople.[44] The workshop was almost certainly a secondary workshop engaged in working with molten glass, since it seems unlikely that an installation for primary glassmaking would have been located within the city. Arabic sources mention mosaic cubes being produced in Constantinople in the 10th century.[45] But it is also possible that the workshop produced glass lamps or vessels or window glass.[46]
- Emesa (modern Homs), in Syria: Symeon Salos (or Symeon the Fool) (6th century) jinxed a Jewish glassblower (*huelopsos*) who was blowing cups and subsequently converted the artisan to Christianity.[47]
- Walarsapat, Armenia: production of glass beads, *c.* AD 300.[48]

Location of workshops

With regard to the location of workshops we learn that bead-making took place on the outskirts of Walarsapat, the capital of Armenia, around AD 300[49] and that hot shops for secondary glass production were located in the heart of Constantinople in the 6th[50] and 10th centuries.[51] One may compare the discovery of the remains of a secondary glass workshop in the centre of Beit She'an (Scythopolis) in Israel, which dates to the 6th to early 7th century.[52]

Organization of the industry

At Oxyrhynchus, the *huelourgoi* were organized in a guild (*koinon tôn huelourgôn*: *POxy* 45, no. 3265; *POxy* 54, no. 3742). Perhaps a guild of *huelourgoi* existed also at Antinoöpolis. The *huelourgoi* were one of 29 categories of labourers, artisans, merchants and other types of workers, all of whom were regarded as groups for tax purposes (*PUG* I, no. 24). The list also includes the names of two individuals, thought by the editor of *PUG* I to be the representatives of other groups or corporations.

Elsewhere most of the artisans appear to have been independent entrepreneurs: three individual *hualourgoi* offer to work on the windows of three bath buildings for a smaller salary than they are currently receiving (*PGot*, no. 7); a *huelourgos* named Aurêlios Loukios, also known as Potamôn, appears in a summons to pay back the loan he received as an individual from a private lender (*PSijp*, no. 17); a blind beggar in Alexandria says he used to be a *huelepsos* (John Moschos, *Patrologia Graeca* 87, 2932A); and two anonymous Jewish glassblowers are mentioned in Christian literature, both of whom appear to have been independent entrepreneurs. The first was the glassblower in Constantinople who threw his son in the furnace because the boy had eaten leftover Eucharistic bread (see above, miracle associated with Menas, patriarch of Constantinople). The other, in Emesa (modern Homs), was converted to Christianity by Symeon Salos.

Names in alphabetical order

The names of six artisans can be added to those already known from signatures on glass vessels and inscriptions:

1. Apiôn, *hualas* (*POxy* 48, no. 3428). The appellation is not a compound. Its meaning is non-committal and can refer to any person engaged with the primary or secondary production, merchandising, or sale of glass. One may compare two Christian tombstones from Athens, 5th (to 6th?) century, on which the deceased's profession is described as οἰαλᾶς (*hoialas*).[53]
2. Aurêlios Loukios, also known as Potamôn, *huelourgos* (*PSijp*, no. 17).
3. Aurêlios, son of Horos, from Koptos, *huelourgos* (*PGot*, no. 7).
4. Kyrikos, *hualepsos* (*PSijp*, no. 36).
5. Mareinos, son of Aurêlios (3) from Koptos, *huelourgos* (*PGot*, no. 7).
6. Sarapodôra, also known as Didymê, *huelourgos* (*PGot*, no. 7).

Women glassworkers

Sarapodora (no. 6) is an interesting case. Both her real name and her nickname are those of a woman.[54] Sarapodora was a citizen of Panopolis.[55] The wording of the papyrus indicates that she acted as an independent entrepreneur on a par with her male colleagues, the two craftsmen from Koptos: Aurelios Horos (no. 3) and his son Mareinos (no. 5). All three are called *huelourgoi*. They offered to work on the *noumenaria* (a scribe's error for *luminaria*, 'windows') of three bath buildings as well as on the windows of other public buildings at Panopolis for a salary of six drachmai and six obols per (square) cubit instead of the eight drachmai they were receiving at the time.

The three glassworkers specify their price per cubit (the distance from the elbow to the tip of the middle finger). This suggests they produced flat windowpanes, measuring approximately 50 x 50cm, the average dimensions of a good-size cast window pane.[56] Ancient bath buildings usually required a considerable amount of glazing. Large windows were often closed with a wooden frame containing multiple panes and sometimes two separate frames were placed one behind the other for extra insulation.[57] In AD 326 the warm baths and the gymnasium at Oxyrhynchus were provided with sufficient glass to cover a surface of 242m^2.[58] This would have amounted to 968 panes of 50 x 50cm, a number that may have been common in many ancient bath buildings.[59]

The production of window glass was probably the most dangerous and physically exacting of all ancient glass working operations. It required a sturdy furnace filled with molten glass and the accompanying poisonous fumes. Pouring ladles of molten glass into a tray for the production of so-called cast matt-glossy panes was heavy work. The hot viscous glass was then pulled out to the edges of the tray, and the panes needed to be stacked carefully for annealing.

Matt-glossy panes had been produced since the first half of the 1st century [60] and continued to be made into Late Antiquity.[61] The cargo of a ship that sank off the French Mediterranean coast in the early 3rd century shows what the glass panes at Panopolis may have looked like.[62] The panes from the shipwreck are relatively thin with a pale green tinge and the borders are slightly thickened, with tool marks from pulling along the edges. However it has not yet been possible to confirm that they were made by pouring and tooling. Flat panes were also made by the cylinder process and it is not always possible to distinguish between the two types of manufacturing. The cylinder process consisted of blowing a cylinder, transferring it to a pontil to open up the mouth, and cutting it lengthwise. The sides were then opened up and flattened to form a flat panel. The technique sounds simple, but it was not at all easy and required dexterity and experience, especially for making large panes. Blowing and manipulating a cylinder large enough to fabricate a square glass pane of 50 x 50cm would have been quite a feat. It probably required even more physical strength than ladling molten glass into a tray. There is no consensus regarding the date when or the area where the cylinder process was first applied. Cylinder-blown window glass became common in Britain in the late 3rd and 4th centuries.[63] However, it seems unlikely that much window glass in the eastern Mediterranean was made by this method in the mid-3rd century, when Sarapodora was active. The examples of cylinder-blown panes cited by Danièle Foy date from the 6th century and later.[64]

Ever since the German historian F.K. Kiechle pronounced his verdict on woman glassblowers: 'Doch kann man sich diese Geschäftsfrau schwerlich selber am heissen Glasofen wirkend vorstellen' (But one can hardly imagine this business woman herself working at a hot furnace),[65] scholars have voiced doubts about the existence of woman glassblowers in antiquity. Women's signatures on glass vessels are explained as signatures of workshop proprietors rather than of artisans. Sarapodora's activity as a producer of window glass was apparently so normal that it invited no comment in the papyrus. If women were active in a trade as dangerous and physically exacting as the production of window glass, it would have been at least as acceptable for them to blow glass vessels, a profession that is less strenuous. (I blew glass myself for many years in Toledo, Ohio.) Whichever method of window glass production Sarapodora and her colleagues employed, the fact that a woman was engaged in this trade is proof that in antiquity glassblowing was not the male-only occupation it became in more recent history. The papyrus (*PGot*, no. 7) is incontrovertible evidence that women worked with molten glass. It sheds new light on the relationship between gender and profession in general and the structure of the ancient glass industry in particular.

A second female glass artisan, active in Armenia around AD 300, is known from several Armenian manuscripts and their translation into Greek by Agathangelos in the 5th century. Her name has not been recorded, but we know that she was one of the companions of Sts Rhipsimia and Gaiana, who fled persecution from the emperor Diocletian around AD 300: 'Τότε οὖν ἐλθοῦσαι φθάνουσιν τὰ ὅρια τῆς Ἀρμενίας, εἰς Ἀραρὰτ τὴν πατρίδα καὶ Οὐαλαρσαπὰτ ἣν καλοῦσι Νεάπολιν, ἐκτισμένην εἰς οἰκητήριον τῶν βασιλέων τῆς Ἀρμενίας. Ἐλθοῦσαι οὖν εἰσέρχονται εἰς τὰς ληνοὺς τῶν ἀμπελώνων, αἵ εἰσιν ᾠκοδομημέναι ἀπὸ βορρᾶ κατὰ ἀνατολὰς καὶ ἐτρέφοντο ἐκ τῶν ἰδίων ἀπὸ τῆς ἀγορᾶς τῆς πόλεως, μηδὲν μὲν ἔχουσαι μεθ' ἑαυτῶν, ἀλλ' ὅτι μία ἐξ αὐτῶν εἰδυῖα ὑελουργεῖν, τῆς ἐφημέρου τροφῆς αὐτῶν ἐχορήγει τὰς χρείας.'[66] (Then on their journey they arrived at the boundary of Armenia, at Ararat, their fatherland, and at Walarsapat also called Neapolis ('New City'), founded as the capital of the kings of Armenia. After their arrival the women entered the winepresses which are built to the northeast [of the city]. They supported themselves with their own earnings at the city market. They had no possessions with them, but one of the women knew how to make glass objects [*eiduia huelourgein*, 'knowledgeable about glassworking'] and she defrayed the cost of their daily food.)[67]

A 16th to 17th-century Latin translation of the earliest Armenian manuscript specifies what kind of glass objects the woman produced: 'et nutriebantur emendo a mercatoribus civitatis, et nihil habebant secum, sed una ex illis erat vitraria et faciebat bacculas vitreas et acquirebat eis mercedem diei'.[68] (They fed themselves by buying food from the merchants in the city. They had nothing with them, but one of the women was a glass artisan, she made glass beads and she provided for their daily income.)[69]

Bead making is the opposite of window glass production as far as tools, equipment and sheer physical strength are concerned. Bead makers do not need a furnace for remelting raw glass. Wound beads can be made above an open fire by softening tiny chunks of preheated raw glass individually at the tip of a short metal rod (mandril) and winding the softened glass around a second mandril.[70] A few mandrils and a shallow pan for preheating the chunks suffice. It would have been no problem whatsoever for the anonymous Christian woman artisan to make beads after her arrival at Walarsapat. Supplies, tools and equipment weighed little. She could easily have carried them with her while fleeing and made beads along the way in order to provide for the refugees' daily needs. Depending on her skill and experience, she could have fashioned attractive colourful glass beads even in the most primitive of circumstances.

Conclusion

Late Antique and Byzantine texts and papyri provide important information about ancient glassblowers, production sites and the organization of the industry. Jewish glassblowers set up shop in Constantinople and Emesa in the 6th century. The main production of *huelourgoi* active in Egypt appears to have been window glass. This is not surprising in view of the large amount of window glass needed for various types of public buildings. From the offer made by the three entrepreneurs to work on the windows of the public buildings in Panopolis, we may perhaps deduce that guilds of *huelourgoi*, as documented at Oxyrhynchus, were not the rule in all Egyptian cities. Glassworkers were active also at Antinoöpolis, in the Arsinoites, at Hermoupolis and Lykopolis. We can add six names of glass

artisans to those already known from signatures on glass vessels and inscriptions.

With regard to gender studies in antiquity, we now have incontrovertible evidence that women blew glass. We have encountered two women who were active in glass production in the second half of the 3rd century: Sarapodora who made window glass and the anonymous bead-maker friend of Sts Rhipsimia and Gaiana. We cannot exclude the possibility that some of the unnamed artisans mentioned in the Greek papyri from Egypt were also women, because the appellations *hualourgos* and *hualepsos* (and their variant spellings) have no separate female forms. They apply to men and women alike.

Acknowledgements

I would like to thank Stefan L. Radt (Groningen) and Klaas A. Worp (Leiden) for reading the manuscript and making numerous useful comments and suggestions. Needless to say, they should not be held responsible for lapses on my part. Sonja Schönauer (Bonn) assisted with literature unavailable in the Netherlands. Last but not least, I thank the University of Groningen for providing access to electronic databases. Without their generous support, the research for this paper could not have been done.

Notes

1 R. Lierke, *Die nicht-geblasenen antiken Glasgefässe/The Non-blown Ancient Glass Vessels* (Deutsche Glastechnische Gesellschaft), Offenbach/Main, 2009, with earlier literature.

2 E.M. Stern, 'Ancient glass in a philological context', *Mnemosyne* 60 (2007), 341–406, esp. 355–67. For Strabo see: *Strabons Geographika*, 4: *Buch XIV-XVII: Text und Übersetzung*, S. Radt (ed.), Göttingen, 2005.

3 *PTebt* II, no. 278, line 20, early 1st century.

4 Date per Cyril Mango, courtesy of Marlia Mundell Mango.

5 On the identification of *hualos*, see Stern (n. 2), 392–7.

6 E.M. Stern, 'Ancient Greek technical terms related to glass production', *Annales de l'Association Internationale pour l'Histoire du Verre, Thessaloniki 2009*, Thessaloniki, 2012, 1–6.

7 M.-D. Nenna (ed.), *La route du verre: Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen Âge* (Travaux de la Maison de l'Orient Méditerranéen 33), Lyon, 2000.

8 E.M. Stern, 'Roman glassblowing in a cultural context', *American Journal of Archaeology* 103 (1999), 441–84, esp. 454–78.

9 *Pseudo-Elias (Pseudo-David): Lectures on Porphyry's Isagoge*, L.G. Westerink (ed. and trans.), Amsterdam, 1967, 25.

10 Stern (n. 8), 450–4.

11 For variant Greek spellings within both groups, see S. Schönauer, 'Glas und Gläser in byzantinischen Texten', in J. Drauschke and D. Keller (eds), *Glass in Byzantium – Production, Usage, Analyses* (Römisch-Germanisches Zentralmuseum), Mainz, 2010, 245–55, esp. 248–9.

12 Stern (n. 2), 388–90.

13 *Cf.* Stern (n. 2), 388–90; Stern (n. 6).

14 Stern (n. 6).

15 Hesychios, Y 105: *Hesychii Alexandrini Lexicon*, IV: Τ-Ω , P.A. Hansen and I. Cunningham (eds), Berlin/New York, 2009.

16 See Johannes Damascenus, 7th–8th century, *Capita Philosophica (Dialectica)* section 8, line 77, in: *Die Schriften des Johannes von Damaskos*, 1, P.B. Kotter (ed.), Berlin, 1969, 71; and, Johannes Doxapatres, writing in Constantinople in the 11th century, in: *In Aphthonii progymnasmata, Prolegomenon sylloge*, H. Rabe (ed.), *Rhetores Graeci* 14, 80–155, Leipzig, 1931, esp. 100, lines 9, 20.

17 Stern (n. 6).

18 Joannes Alexandrinus 29: 'Ioannis Alexandrini in Hippocratis de natura pueri commentarium', T.A. Bell (ed.), in: *Ioannis Alexandrini epidemiarum librum VI commentarii fragmenta*, J. Duffy (ed.), *Corpus Medicorum Graecorum* XI 1,4, Berlin, 1997, 130ff., esp. 222 (Bell 156, line 6).

19 On Aristotle, *Meteora* IV.9, *cf.* Olympiodoros, *Olympiodori in Aristotelis meteora commentaria*, G. Stüve (ed.), Berlin, 1900, 331.

20 *Scholia in Lucianum*, H. Rabe (ed.), Leipzig, 1906 (repr. Stuttgart 1971), esp. 197.

21 E.M. Stern, 'Ancient glass in Athenian temple treasures', *Journal of Glass Studies* 41 (1999), 19–50, esp. 41.

22 Didymus Caecus, codex, 329, lines 13–17: *Didymos der Blinde: Psalmenkommentar (Tura-Papyrus)*, part 5, M. Gronewald (ed.), Bonn, 1970, 194–5.

23 J. Diethart, 'Hinter Personennamen "versteckte" Berufsbezeichnungen im byzantinischen Griechisch mit einem Exkurs über Beinamen nach Berufen in den Papyri', *Münstersche Beiträge zur Antiken Handelsgeschichte* XXV 2 (2006), 195–236, esp. 227.

24 Schönauer (n. 11), 249, after F.G. Welcker, 'Inscriptio spartana', *Bullettino dell'Instituto di Corrispondenza Archeologica* (1844), 147–52, esp. 150.

25 Welcker (n. 24), line 24.

26 G. Henzen, 'Inscriptio spartana', *Bullettino dell'Instituto di Corrispondenza Archeologica* (1844), 145–6; M.N. Tod and A.J.B. Wace, *A Catalogue of the Sparta Museum*, Oxford, 1906, 32–3.

27 Welcker (n. 24).

28 Tod and Wace (n. 26), 18–19. See also H.G. Liddell and R. Scott, *A Greek-English Lexicon*, Oxford, 1958.

29 Stern (n. 2), 388–90; Stern (n. 6).

30 A. Oliver, 'A glass opus sectile panel from Corinth', *Hesperia* 70 (2001), 349–63.

31 L. Ibrahim, R. Scranton and R. Brill, *Kenchreai Eastern Port of Corinth*, 2: *The Panels of Opus Sectile in Glass*, Leiden, 1976.

32 Stern (n. 8), 442–54.

33 *Pratum spirituale, cf. Patrologia graeca*, J.P. Migne (ed.), Paris, 1857–, vol. 87, 2932A; V. Arveiller-Dulong and M.-D. Nenna, *Les verres antiques du Musée du Louvre*, II: *Vaisselle et contenants du Ier siècle au début du VIIe siècle après J.-C.*, Paris, 2005, 468–9.

34 Nenna (n. 7), 97–112.

35 Pers. comm. M.-D. Nenna, 2010.

36 *Cf.* Stern (n. 8), 464–6.

37 H.-J. Drexhage, 'Zu den Berufsbezeichnungen mit dem Suffix -ᾶς in der literarischen, papyrologischen und epigraphischen Überlieferung', *Münstersche Beiträge zur Antiken Handelsgeschichte* XXXIII 1 (2004), 18–40.

38 J. Diethart, 'Bemerkungen zu Papyri IV 43.–51.', *Tyche* 6 (1991), 233–6, esp. 235, no. 49.

39 P.J. Sijpestein, 'Einige Papyri aus der Amsterdamer Papyrussammlung', *Zeitschrift für Papyrologie und Epigraphik* 9 (1972), 43–53, esp. 49.

40 Pers. comm. K.A. Worp, 2011.

41 T.S. Skeat, *Papyri from Panopolis in the Chester Beatty Library Dublin*, Dublin, 1964, xxxii–iii.

42 E.g. Evagrios 185, 6th century: *The Ecclesiastical History of Evagrius with the Scholia*, J. Bidez and L. Parmentier (eds), London, 1898 (repr. London 1979), 185; Joannes Moschos, *Pratum spirituale*, 6th–7th century (*Patrologia graeca* 87, 2932a; *cf.* E. Mioni, 'Il Pratum Spirituale di Giovanni Mosco', *Orientalia christiana periodica* 17 (1951), 61–94, esp. 93); *Vita S. Menae patriarchi* (*Acta sanctorum* 1741, 170): *Acta sanctorum quotquot toto urbe coluntur, vel a catholicis scriptoribus celebrantur Augustus* (1733–43), vol. 5: *Acta sanctorum* 1741, *Augustus 25–26*, Joannes Bollandus, Antwerp, 169–71, 'Vita auctore anonimo: Ex Ms. Codice bibliotheca Caesarea Vindobonensis. Interprete J[oannes] P[inius]'.

43 E.g., Georgios Monachos, 9th century (*Patrologia Graeca* 110, 809; *Georgii monachi chronicon*, C. de Boor and P. Wirth (eds), Leipzig, 1904 (repr. Leipzig 1978 [cited after *TLG* 3043.001], 655), Kedrenos, 11th century (*Patrologia Graeca* 121, 687), and Glykas, 12th century (*Michaelis Glycae annales*, I. Bekker (ed.), *Corpus Scriptorum Historiae Byzantinae*, Bonn, 1836 [cited after *TLG* 3047.001], 506).

44 *Vita et miracula sanctae Photinae* 247: *Hagiographica inedita decem*, F. Halkin (ed.), Turnhout, 1989, 111–25, esp. 122; date per C. Mango, pers. comm. via M. Mundell Mango 2008.

45 C.J. Lamm, *Mittelalterliche Gläser und Steinschnittarbeiten aus dem Nahen Osten*, I: *Text*, Berlin, 1930, 486–7, excerpt no. 12; A.C. Antonaras,

'Early Christian and Byzantine glass vessels: forms and uses', in F. Daim and J. Drauschke (eds), *Byzanz – das Römerreich im Mittelalter*, I: *Welt der Ideen, Welt der Dinge* (Monographien des Römisch-Germanischen Zentralmuseums, Band 84.1), Mainz, 2010, 383–430, esp. 395.

46 On the window glass of the period: F. Dell'Acqua, 'Enhancing luxury through stained glass, from Asia Minor to Italy,' *Dumbarton Oaks Papers* 59 (2005), 193–211.

47 *Vita et miracula sancti Symeonis Sali* 1736D, 1744D: *Das Leben des heiligen Narren Symeon von Leontios von Neapolis*, L. Ryden (ed.), Uppsala, 1963, 163 (English translation of the relevant passage by Stern [n. 6]).

48 Agathangelos 66, *La version grecque ancienne du livre arménien d'Agathange*, G. Lafontaine (ed.), Louvain-la-Neuve, 1973, 232; *cf.* G. Garitte, 'La passion des saintes rhipsimiennes', *Le Muséon* 75 (1962), 233–51, esp. 239–40.

49 Aganthangelos 66, *cf.* Garitte ibid., 239–40.

50 Mioni (n. 42), 93–4.

51 M. Mundell Mango, 'The commercial map of Constantinople', *Dumbarton Oaks Papers* 54 (2000), 189–207, esp. 202.

52 Y. Gorin-Rosen, 'The ancient glass industry in Israel: summary of the finds and new discoveries,' in Nenna (n. 7), 49–63, esp. 59–60.

53 *Hoialas*, a variant spelling for *hualas*. *Cf.* E. Sironen, *The Late Roman and Early Byzantine Inscriptions of Athens and Attica*, Helsinki, 1997, no. 72 (Euphrasios), and no. 113 (Andreas).

54 On women glassblowers in antiquity, see E.M. Stern, 'Neikais – a woman glassblower of the first century AD?', in G. Erath, M. Lehner and G. Schwarz (eds), *Komos: Festschrift für Thuri Lorenz zum 65. Geburtstag*, Vienna, 1997, 129–32; E.M. Stern, 'A corpus of mouldings and signatures on glass vessels with some thoughts on Sentia Secunda', *Journal of Roman Archaeology* 21 (2008), 501–4, esp. 502–3.

55 Skeat (n. 41), xxxiii.

56 On the size of cast window panes: S.D. Fontaine and D. Foy, 'La modernité, le confort et les procédés de fabrication des vitrages antiques', in D. Foy (ed.), *De transparentes spéculations: Vitres de l'antiquité et du Haut Moyen Âge (Occident-Orient)* (Musée/Site d'Archéologie Bavay-Bagacum), Bavay, 2005, 15–24, esp. 23.

57 H. Broise, 'Vitrages et volets des fenêtres thermales à l'époque impériale', in *Les thermes romains (Actes de la table ronde organisée par l'École Française de Rome, 1988)*, Rome, 1991, 61–78, esp. 62–3.

58 Stern (n. 8), 465.

59 Fontaine and Foy (n. 56), 18.

60 Ibid., 15.

61 R. Kucharczyk, 'Les vitres de Marea (Égypte)', in Foy (n. 56), 121–6, esp. 123, citing an example from Marea in Egypt.

62 S.D. Fontaine and D. Foy, 'Une cargaison fragile: les vitres de l'épave Ouest Embiez 1', in Foy (n. 56), 38–41.

63 J. Price, 'Glass', in R.P.J. Jackson and T.W. Potter (eds), *Excavations at Stonea Cambridgeshire, 1980–85*, London, 1996, 379–409, esp. 396.

64 D. Foy, 'De l'autre coté de la Méditerranée: Le verre à vitre à la fin de l'Antiquité et au début de l'époque islamique', in Foy (n. 56), 111–17, esp. 113.

65 F.K. Kiechle, 'Die Struktur der gewerblichen Glaserzeugung in der frühen Kaiserzeit', *Annales de l'Association Internationale pour l'Histoire du Verre 6, Cologne 1973*, Liège, 1974, 53–64, esp. 63.

66 Agathangelos 66: Lafontaine (n. 48), 232.

67 Translation by the author.

68 Garitte (n. 48), 239–40.

69 Translation by the author.

70 T. Gam, 'Prehistoric glass technology: Experiments and analyses', *Journal of Danish Archaeology* 9 (1990), 203–13; T. Gam, 'Experiments in glass, present and future', *Annales de l'Association Internationale pour l'Histoire du* Verre 12, *Vienna 1991*, Amsterdam, 1993, 261–70.

Abbreviations (papyri)

BGU, *Aegyptische Urkunden aus den Staatlichen Museen zu Berlin* 19, *Urkunden aus Hermupolis*, H. Maehler (ed.), *Archiv für Papyrusforschung und verwandte Gebiete*, Beiheft 19, 2005.

PBad, *Griechische Papyri*, F. Bilabel (ed.), *Veröffentlichungen aus den badischen Papyrus-Sammlungen*, Heidelberg, 1924.

PGot, *Papyrus grecs de la Bibliothèque Municipale de Gothembourg*, H. Frisk (ed.), Gothenburg, 1929.

POxy, *Oxyrhynchus Papyri*, B.P. Grenfell and A.S. Hunt (eds), London, 1898–.

PRyl, *Catalogue of the Greek Papyri in the John Rylands Library, Manchester*, 2: *Documents of the Ptolemaic and Roman Periods*, J. de M. Johnson, V. Martin, A.S. Hunt (eds), Manchester, 1915.

PSijp, *Papyri in Memory of P.J. Sijpesteijn*, A.J.B. Sirks and K.A. Worp (eds), *American Studies in Papyrology* 40, 2007.

PTebt, *The Tebtunis Papyri* II, B.P. Grenfell, A.S. Hunt, E.J. Goodspeed (eds), London, 1907.

PUG I, *Papiri dell'Università di Genova*, I.M. Amelotti and L. Zingale (eds), Milan, 1974.

TLG, *Thesaurus Linguae Graecae*, online electronic database.

Chapter 11
On the Manufacture of Diatreta and Cage Cups from the Pharos Beaker to the Lycurgus Cup[1]

Rosemarie Lierke

Introduction

Roman diatreta or cage cups are true marvels of ancient cut glass. It is usually assumed that they are made by cutting and grinding a thick-walled blown blank. However, it seems necessary to review this perception. The Römisch-Germanisches Zentralmuseum in Mainz owns a fragment of a diatretum of unknown provenance (**Pl. 1a–c**).[2] This fragment shows a certain stylistic resemblance to the Lycurgus cup (**Pl. 20**), without sharing the vessel's dichroic effect. Significant features are the thin and gently curving walls connecting the blue outer layer and the colourless inner layer of the fragment, consequently enclosing cavities between the layers. These cavities and their walls do not look like they were created by cutting or grinding from a thick-walled blank as they do not show any such signs.

One is reminded of the diatretum fragments from Athens which were recently re-published by Marianne Stern (**Pl. 2a–d**).[3] A comparable thin-walled cavity appears here on the interior or reverse of the bird fragment. Especially striking is the interior or reverse of the leaf fragment. It shows no signs of cutting or grinding as one would expect from a glass vessel which was cut from a thick-walled blank.[4] A comparison with the reverse of the arm of the fragment in Mainz (**Pl. 1c**) reveals that this also appears partly untouched by grinding except on the edges. Unfortunately, corrosion disturbs the picture here.

The fragment in Mainz instigated a renewed search to find out whether any other extant diatreta glasses show features caused by hot-forming methods. The search indeed provided such evidence. The investigated examples were

Plate 1a–c Diatretum fragment, part of a bearded man's face and body, provenance unknown, 4th century a: front, ht 49mm; b: view from right side; c: reverse. Römisch-Germanisches Zentralmuseum, Mainz (inv. no. O2259)

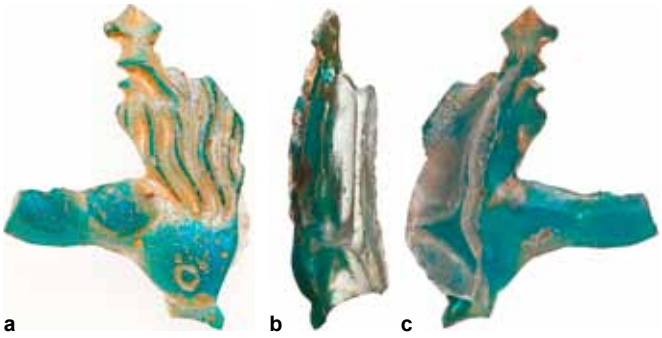


Plate 2a–d Two (of eight) diatretum fragments from the Athenian Agora, dated not later than AD 267 a–b: front and back of the bird breast fragment, l. 42mm; c–d: front and back of leaf fragment, the reverse with part of a clear glass bridge, l. 36mm. National Archaeological Museum, Athens (nos G547a and G547d)

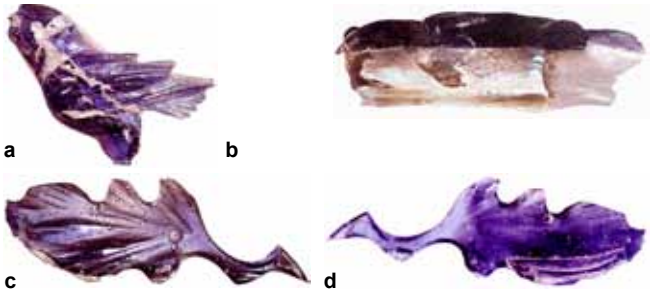
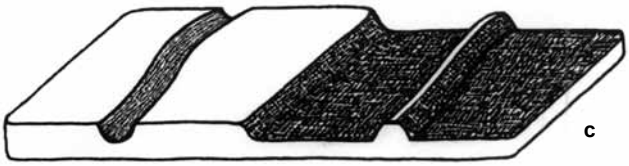


Plate 3 Openwork vessel (diatretum) found in 1982 in a Roman grave in Nijmegen, dated AD 80–100, ht 135mm. Museum Het Valkhof, Nijmegen

a

b



c

Plate 4a–c a: Beaker with high relief from Rome, second half of 1st century, ht 113mm. Antiquarium Comunale, Rome (no. 279); b: plaster mould with engraved groove after wax model; c: while a groove in the glass is created with one stroke of a wheel, a ridge or rib takes countless tiny facets to 'model' the ridge and the new background

clearly not made from simple thick-walled blown blanks. A logical progress of diatreta manufacturing techniques seems to have taken place, starting with the making of early high relief vessels.

The openwork vessel from Nijmegen and the significance of protruding ridges

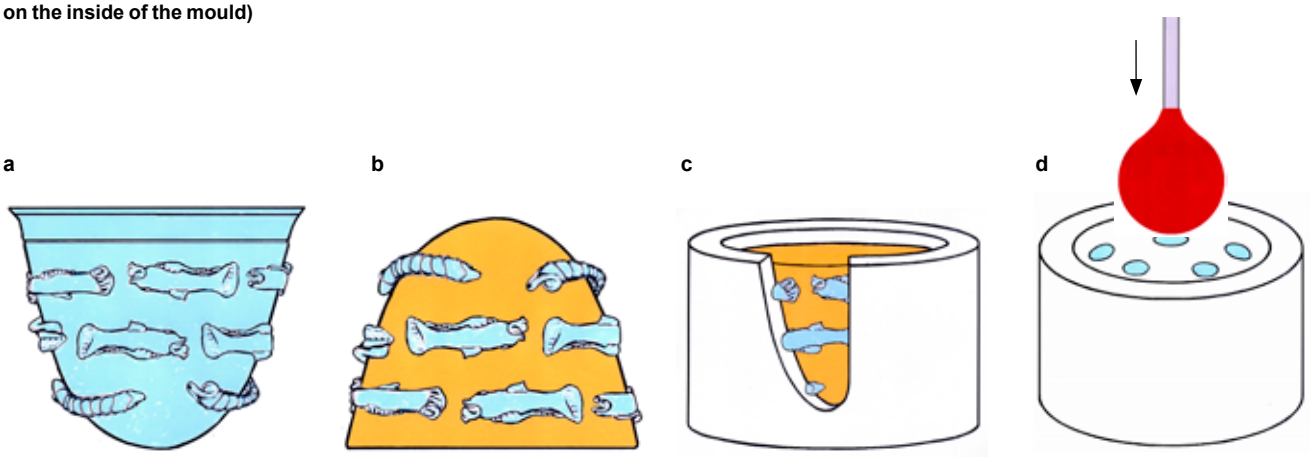
An exceptionally early 'diatretum' is the openwork vessel from Nijmegen (**Pl. 3**). From its first publication,[5] its resemblance to two beakers from Begram[6] and one beaker from Rome (**Pl. 4a**)[7] has been noted. It had been presumed that all of these beakers were made by wheel-cutting from a thick-walled blank. However, in 1954 Pierre Hamelin called the relief of the two Begram beakers 'relief à chaud', meaning 'hot-formed relief'. The beaker from Rome provides several clues about its manufacture which suggest a similar conclusion: on a remarkably smooth background, it features a ridge at the rim and an ivy tendril in very high relief with at least one leaf pointing outwards free from the wall. This raises doubts as to whether the relief was cut. The thickness of the wall at the farthest protruding point determines the overall wall thickness of a hypothetical cutting blank, and therefore also the amount of material which would have to be removed painstakingly all around the vessel to create the high relief. The wall thickness also determines the annealing time and the critical cooling rate required to relieve any stress from a potential cutting blank after its manufacture.[8] The thicker the wall, the more critical the cooling becomes. Since a reliable temperature control was not yet possible in antiquity, stress-free cooling of a thick-walled blank posed a serious technical problem. For this reason, caution is needed when describing a high relief glass as cut. Alternative manufacturing methods should be considered.

The early high relief glasses from the 1st century – such as the beaker from Rome (**Pl. 4a**) – usually have remarkably simple yet distinctive protruding decorative elements.[9] Their smooth background is usually the largest area of the vessel surface, but it shows no evidence of grinding. Some of these early high relief glasses may have been made with applied decoration, but the majority look like they were pressed into a mould. True relief-cut glass appears in the 4th century.[10] Here the vessel's original surface before cutting is partly preserved as the upper surface of the relief, while the background of the relief shows traces of cutting and grinding all over.

There is little doubt that the beaker from Rome was pressed – with or without its ivy tendril. The ivy tendril may have been applied to a pressed beaker. But a vessel like the Rome beaker could also be pressed together with the tendril. The artisan would have prepared a wax model of a beaker with tendril, cast a plaster mould from the model, melted out the wax and engraved a groove into the plaster mould to create the ridge at the rim of the beaker (**Pl. 4b**). Carving a ridge in glass instead would have been an extremely laborious task (**Pl. 4c**).

No glass furnace or crucible filled with molten glass was necessary for manufacturing one glass vessel in the plaster mould. A pre-heated chunk of raw glass could be picked up on the glowing tip of a metal rod and heated in the fire until it became viscous.[11] The heat was intensified by an additional air supply, for instance with the aid of bellows. The viscous glass was pressed into the mould to make a vessel. Water evaporating from the plaster mould temporarily created a thin layer of steam between the mould and the glass and ensured a shiny glass surface without polishing.[12] After it was pressed, the beaker was cooled down as carefully as possible, perhaps in a heap of hot ashes. With the loss of the crystal-bound water, the plaster mould would have lost its stability. It could easily be broken off from the finished glass at any time after use, or be rinsed off with water after the vessel was annealed. For some details, subsequent engraving may have been used.

Plate 5a–d a: *Konchilienbecher* or beaker with sea creatures; b: wax model with prepared glass fish and sea creatures; c: mould with appliqués enclosed; d: glass blown into mould (contact areas visible on the inside of the mould)



It is very important to understand that pressed glass in antiquity was not mass-produced. A plaster mould could only be used once. The value of ancient pressed glass is comparable to that of cast bronze where a model and a mould were also employed. Ancient pressed glass cannot be compared with the mass-produced pressed glass of today.

Protruding round ridges or mouldings are a common feature of ancient glasses, especially in the 1st century, and they reappear in the 3rd century (see n. 9). One or two such ridges can be seen for instance at the rim of numerous 1st-century facet cut or painted beakers.[13] It is most unlikely that these ridges were produced by reducing the wall-thickness all around the vessel by the risky and time consuming process of grinding and polishing. They were made neither by mould-blowing nor by winding glass threads around the vessel. Pressing remains the most likely method to produce the typical protruding ridges.

Looking at the Nijmegen vessel, one can still distinguish two ridges at the rim, the fully rounded tendrils and several freely protruding leaves. This suggests that hot forming, most likely pressing and an application of pre-formed elements was involved in its making. It is especially interesting that, according to Annelies Koster, 'small bridges attach the wall of the goblet to the twigs'.[14] As discussed in the next section, these small bridges indicate a pressing process as the ridges also do.

One of the two Begram beakers mentioned above has two ridges at the rim,[15] while the other one has a ridge or moulding a little below the rim just like the majority of the known diatreta or cage cups (see **Pls 6**, **9**, **11**, **13**).[16] Again, grinding such a ridge would be a laborious project. It would need countless tiny facets to 'model' the protruding ridge and its background by abrasion (**Pl. 4c**). Since the ridges could also be moulded or rather pressed, it seems reasonable to consider pressing as a method involved in the manufacture of these vessels – as well as in the production of the blanks of cage cups or diatreta decorated with a ridge under the rim.

A. Diatreta with applied figures: the Budapest fish diatretum and the Pharos beaker

A short detour to another group of vessels may clarify the manufacturing process which will be suggested for diatreta with applied figures. The early 4th-century beakers decorated with three-dimensional sea creatures – known as *Konchilienbecher* in German – were blown (**Pl. 5a**).[17] The vessels usually show one or two cut grooves instead of the ridges seen on pressed glass. The fish and sea creatures applied to the wall were shaped by hot working; they show no traces of cutting. It is a problem with this kind of vessel that the creatures easily break off, barely leaving a mark where they were once attached. Only the squid are additionally secured with glass threads, which represent their tentacles.[18] The weak bond between the applied creatures and the vessel wall is due to the manufacturing method. The prefabricated fish could have been applied to the vessel's wall by rolling the hot, blown glass over the spread out appliqués. But the number of appliqués and their careful placement on the wall suggest yet another possibility: the prefabricated fish may have been affixed to a wax model of the vessel (**Pl. 5b**), the model then placed upside down in a bucket or surrounded by a shell of clay, plaster poured over the model and the attached animals,[19] and the whole thing turned over again to serve as a mould (**Pl. 5c**, here still shown with the wax inside). After melting out the wax, the fish were enclosed in the plaster, leaving only their contact surface visible on the inside of the mould. Hot glass could be blown into the reheated mould to fuse with the fish where contact was possible (**Pl. 5d**). The heat would cause the plaster to lose its stability so the mould could be broken off, or it could simply be rinsed off once the glass vessel with the fused on fish and sea creatures was annealed.

Back to the diatreta. Whilst the Budapest fish diatretum (**Pl. 6**)[20] reminds us of the beakers with sea creatures, it really is an example of a diatreta vessel. The openwork lettering and the collar received their final shape by cutting. The fish and sea creatures feature cut details as well. Usually it is assumed that this vessel was made in the same way as the rock crystal lamp from the Treasury of San Marco in Venice (**Pl. 7**),[21] by cutting the whole vessel from a thick-walled or even from a solid blank. However, the wall of the rock crystal vessel is about three times as thick as that of the glass vessel. The thick-walled creatures on the lamp have a straight cylindrical bore, whereas the glass fish and creatures on the diatretum are thin-walled and hollow. The rock

Plate 6 The Budapest fish diatretum, early 4th century, ht 116mm. Magyar Nemzeti Múzeum, Budapest (inv. no. 23.1894.2)

crystal lamp does not have a ridge below the rim, but the Budapest fish diatretum does. This suggests that the diatretum may have been pressed, especially since there are no grinding marks on its surface.[22] There is no reason to assume that both vessels were made in the same way, although they do have certain details in common; for example, bridges or socles (supports providing a stronger bond than a bridge) connect the tails and bodies of the fish with the wall of the rock crystal lamp just as on the diatretum. It is significant that the *Konchilienbecher* do not feature such bridges or socles. There is no easy way to insert bridges of exact length between the vessel wall and several appliqués on a blown vessel.

Plate 7 Rock crystal lamp, 4th century, diam. 138mm. Treasury of San Marco, Venice (no. 50)

The upper part of the fish diatretum was made as a result of a combination of methods similar to those employed in the production of network-cage cups (see below). The following discussion is limited to the manufacturing of the vessel's bottom part. Three fishes and three other sea creatures are attached to this part in an orderly fashion, supported by bridges and socles (**Pl. 8a**). The ancient artisan could have prepared a wax model and fastened prefabricated glass fish and other creatures onto it with socles and bridges of wax. A plaster mould created from such a model would enclose the glass animals and their wax supports. After the wax is melted out, cavities remain where the wax socles and bridges had been previously (**Pl. 8b**). When hot glass is pressed into the mould with an appropriate fitting plunger (see the pressing process of **Pls 12**, **14**), the glass also fills the cavities (**Pl. 8c**). In other words the socles and bridges are pressed together with the vessel wall. The glass spreads into and through the cavities in the plaster mould until it reaches and fuses with the enclosed glass animals. Such glass supports, pressed from very hot glass together with the wall, created a stronger bond between the vessel and the attached elements than the direct bond between the sea creatures and the blown walls of the *Konchilienbecher*. The *Konchilienbecher* were not cut at all while the final cutting of the upper part of the Budapest diatretum with its lettering and collar was extended to the fish and sea creatures on the underside. The cross-hatching on the shells of the sea creatures, for instance, was cut.

A view of the Pharos beaker (**Pl. 9**)[23] suggests that it was made in the same way as the lower part of the Budapest fish diatretum. The Pharos and three ships were prefabricated. They are connected to the beaker by socles and bridges, or by a wider contact surface. The ridge under the rim tells us that the beaker itself may have been pressed. David Whitehouse has already noted that the attached elements project almost 2cm from the wall of the vessel: 'If it [the vessel] was produced entirely by grinding and cutting, the

Plate 8a–c a: The bottom of the fish diatretum with its appliqués. Socles and bridges are indicated; b: mould of vessel bottom with site of cross cut indicated; c: detail of mould cross-cut with pressed-in hot glass

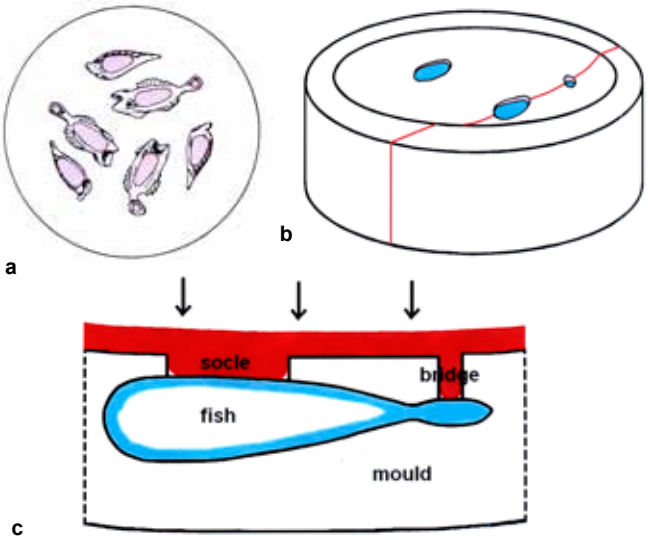


Plate 9 The Pharos Beaker from Begram (Afghanistan) with the Pharos on the left side, height of restored vessel 180mm. Kabul Museum, Kabul

Plate 10 Original fragment with the Pharos. Kabul Museum, Kabul

blank would have been extraordinarily thick and the task of finishing the object would have been prodigious.'[24] He therefore considered the possibility that the blank 'already contained the rudiments of the decoration … either cast or applied'. We should accept the fact that the Pharos beaker was not cut from a thick-walled blank. One would expect the original surface of a hypothetical cutting blank to be preserved in part in the highest areas of the relief, as can be seen in examples of true cut relief (see n. 10). But this is not the case. Even the more or less flat Pharos plate is not part of an original smooth surface. The elaborate ships and the Pharos plate seem to have been prepared separately. They were then affixed to a wax model of the beaker with supporting bridges and socles of wax, and the beaker was made as described above: a plaster mould was taken from the model, the wax was melted out and hot glass pressed into the reheated mould. Finally, a few details were added by cutting and engraving.

B. Diatreta cut from a double-walled blank: the figural and the geometrical cage cups

The manner in which the Pharos plate was applied with bridges and socles to the Pharos beaker (**Pls 9–10**), suggests the possibility that such a plate – of slightly different shape – could have been made by cutting from a separate outer shell of the vessel, and that certain diatreta were made by carving figures into the outer shell of a double-walled (or 'double-shelled') blank. Such beakers really deserve the name 'cage cup'.

The Cagnola cup in Varese (**Pl. 11**)[25] has a ridge under the rim just like the Budapest diatretum and the Pharos beaker. The Cagnola cup's outer shell has become a delicate cut openwork cage connected by bridges to an inner cup. The vessels with individually attached elements show how bridges and socles could be pressed from the vessel wall through the cavities of a plaster mould until they reached and fused with the enclosed appliqués. From this manufacturing process it is just a small step to the manufacture of a double-walled blank (**Pl. 12a–e**). The outer shell is pressed first. Then the artisan inserts a perforated plaster mould. The mould for the Cagnola cup had straight and wedge-shaped perforations. The second step is the pressing of the inner cup. The plunger forces part of the glass through the perforations of the inserted mould creating glass bridges which fuse with the outer shell.[26] The flared rim could be pressed with the vessel, or it could be flared by tooling, or by the centrifugal force of fast turning. Any bubbles in the rim would become horizontally elongated no matter what method was used to flare the rim.

The manufacturing method of cage cups with a geometrical net of roughly circular meshes (**Pl. 13**)[27] is the same as just described for the figural cup from Varese, except the perforations of the inserted plaster mould are arranged in a different pattern (**Pl. 14a**). It should be mentioned here that the two steps of pressing a double-walled blank (**Pl. 12 a**, **c**) could be combined. That means that both walls could be pressed at the same time and just

Plate 11 The Cagnola cage cup, provenance unknown, second half of the 4th century, ht 114mm. Musei Civici di Villa Mirabello, Varese (inv. no. 1050)

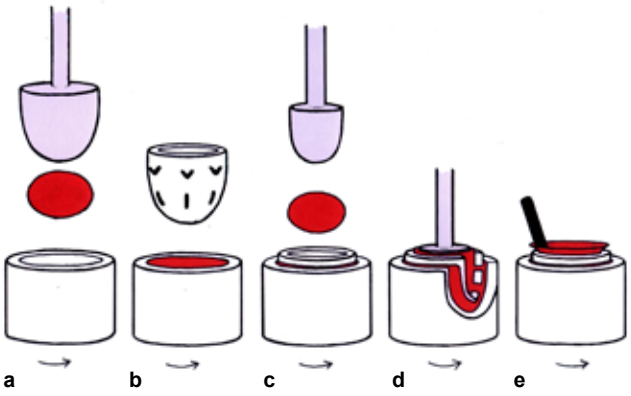


Plate 12a–e (left) The making of a double shell blank a: pressing the outer shell; b: inserting a perforated plaster cup; c–d: pressing the beaker with the bridges through the perforations; e: flaring the rim

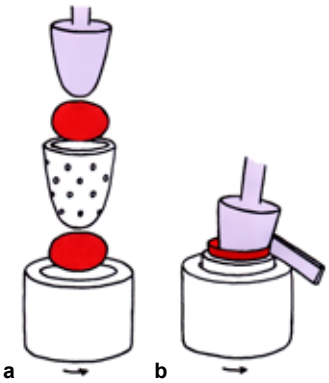


Plate 14a–b (right) a: The making of a double shell blank by pressing in one step; b: flaring the rim

one plunger was needed (**Pl. 14b**). Both methods, pressing in two steps and combined pressing in one step, may have been used to produce the cutting blanks for cage cups. However, if the cup and the cage have different colours which meet somewhere within the glass bridges, the vessel must have been pressed in one step.[28]

The characteristic ridge just below the rim was either created by the upper edge of the inserted plaster mould (**Pl. 15a**) or by a groove in that mould. This perforated mould was still inside the double-walled blank after cooling. In this state, the blank would be handed over to the *diatretarius*, the cutter of cage cups. With eight cut notches for one mesh, he cut openings into the outer shell (**Pl. 15b**). In the corners, the notches automatically created the basic shape of the characteristic mesh-cross ornaments (**Pls 15c**, **16a**). This is noteworthy since these ornaments present obstacles for the cutters of replicas today. It is hard to believe that the Romans deliberately and consistently complicated their work by creating these ornaments over and over again without a sound reason. The *diatretarius* completed his work by removing the plaster between the shells, by 'thinning' the originally thick round bridges (**Pl. 16b**), and by embellishing the vessel with some cutting and engraving. The cut-out shards (**Pl. 15b**) could be recycled and therefore the glass material was used most economically. Very little grinding dust really went to waste. This differs considerably from the traditionally assumed method of cutting from a thick-walled blank where three quarters of the glass material would have been wasted as unrecyclable abrasive-contaminated grinding dust.

Because of its special preparation, a pressed double-walled cutting blank was already an object of considerable value. This most probably was the reason why the liability of the *diatretarius* became limited by an edict of Ulpian:[29] the cutter was not liable for the quality of the final product if the cutting blank was defective. After all, the enclosed perforated plaster mould could hide flaws or imperfections. For a simple thick-walled blown or pressed blank, such an exemption from liability would not have been required. Flaws or imperfections in a thick-walled blank would have been immediately visible. Any remaining stresses caused by insufficient cooling could have been detected with a few sharp scratches: a stressed thick-walled blank would not survive these scratches without cracking; but, a cracked thick-walled blank could easily be recycled. The risk or loss in this case would have been minor and no material would have been wasted.

The cutting process described here to open the meshes of the cage did not usually touch the inner cup or the inside of

Plate 15a–c a: cross section of a double shell blank with the perforated beaker still enclosed; b: opening the outer shell with eight notches for one mesh. Re-meltable cut-out shards are created; c: the finished cage cup with its reticulated ornaments

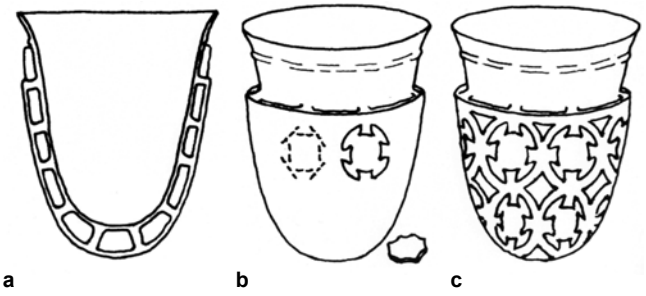


Plate 13 The Niederemmel cage cup, found in 1950 in a grave, dated about AD 300, ht 180mm. Rheinisches Landesmuseum, Trier (inv. no.50,15)

Plate 16a–b a: a cutting wheel opens the meshes and creates the mesh cross ornaments; b: a cutting wheel 'thins' the bridges under the net-work ornaments. It may cause circular grinding traces on the vessel wall or the underside of the net

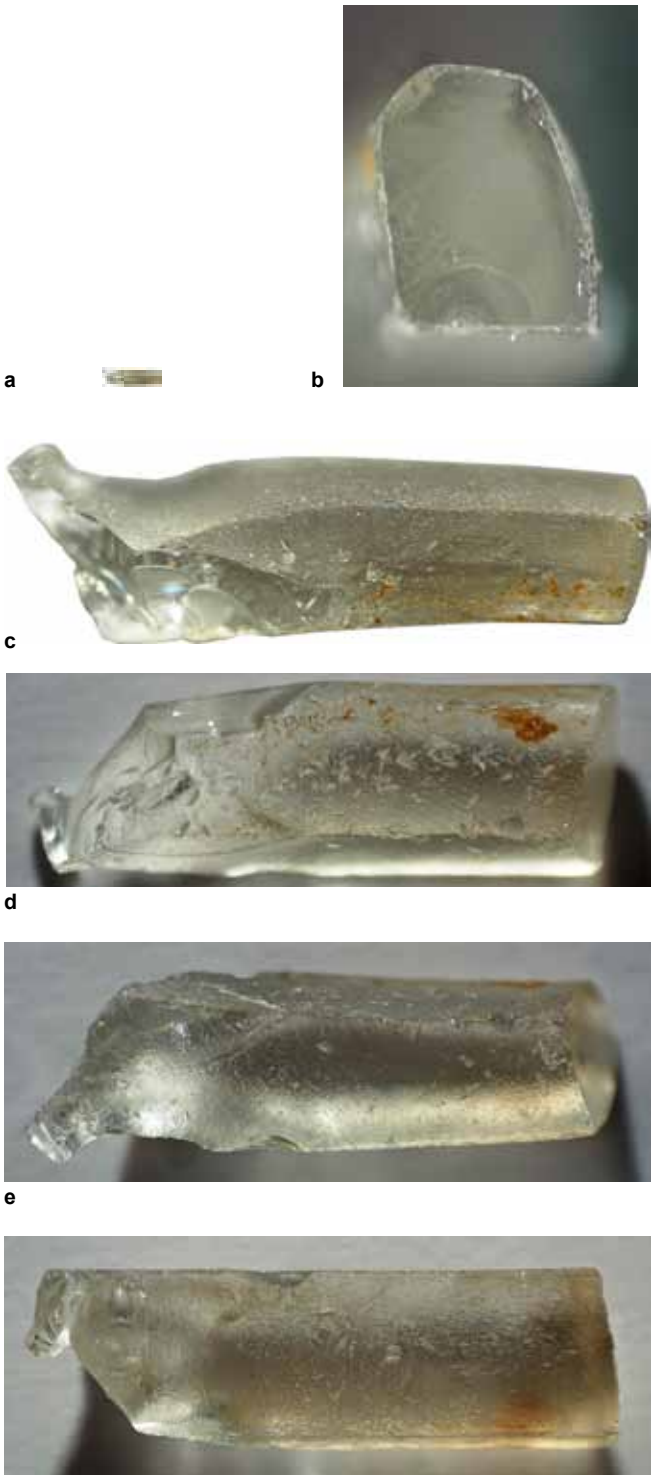


Plate 17a–f a: a tiny mesh fragment of the Niederemmel Cup, l. 7mm. Haevernick Collection, Glasmuseum, Wertheim (inv. no. NH 4613); b: cross section of the fragment; c: front of mesh (net, outside); d: the concave mesh side (the shiny reverse side is visible below); e: the shiny reverse of the mesh (net, inside); f: the convex side of the mesh (b–f: about 10 times enlarged)

the outer shell. Cutting or grinding marks are therefore not necessarily to be expected on these areas. This differs fundamentally from what is to be expected if a cage cup or diatretum had been cut from a thick-walled blank. In that case traces of cutting or grinding are to be expected everywhere. In fact, the Niederemmel cage cup (**Pl. 13**) for example shows almost no traces of grinding on the exterior of its inner cup,[30] and there are no evident signs of cutting on the underside of the net meshes. All sides of a tiny mesh fragment (**Pl. 17a–f**) are rough from the cutting process, except the interior or reverse (**Pl. 17c**) which shows a few scratches, but only in the neighbourhood of the mesh-cross ornament. No grinding and, of course, no polishing was applied to the inside of the net.[31]

Cage cups usually served as lamps.[32] This is why the bridges, which were originally thick and round, were 'trimmed' with a grinding wheel to become thin angular shanks (**Pl. 16b**). The thin shanks disappeared thereafter under the mesh-cross ornaments and did not cause additional shadow. The side of the wheel could touch the wall of the cup or the underside of the net, during the grinding of the bridges. The traces of this grinding process are illustrated by a semi-automatic drawing of a diatretum or cage cup fragment in Cologne (**Pl. 18**).[33] The irregularity and crudeness of the grinding as documented by this drawing and as shown by a detailed photograph of cage cup shanks (see n. 59) is astonishing. However, the circular grinding marks around the shanks are the most numerous, most pronounced and most typical traces of grinding seen on cage cups. They appear on the exterior of the cups' wall and/or the reverse of the meshes of cage cups. But beakers without or almost without such traces exist – like the Niederemmel Cup mentioned above (see n. 30). In other words the circular grinding marks on the vessel wall or on the reverse of the net sometimes could be avoided with a better tool, a thinner wheel, longer shanks, thinner pressed shanks or with special care.

The thickest shank stump of the cage cup fragment illustrated in **Plate 18** is still partly circular.[34] This shows that the bridges were originally round, and most were thick because large perforations facilitated pressing the hot glass through the perforated mould. Anton Kisa mentions round shanks, and he discovered among the very long shanks of the lost Hohensülzen cup some which did not reach the net. Their tips were round (**Pl. 19**).[35] It is difficult to explain how this could have happened if the shanks were cut from a thick-walled blank. Kisa's observation is in agreement with scientific investigations initiated in 1959 by T.E. Haevernick which revealed that the bridges are always homogeneously connected to the inner beaker.[36] This is not surprising if my hypothesis that the bridges were pressed simultaneously with the vessel wall is correct.[37]

C. A diatretum made by undercutting a pressed high relief: the Lycurgus cup

Ridges under the rims were the first indication that the cutting blanks of cage cups may have been pressed. We do not know whether the Lycurgus cup (**Pl. 20**)[38] featured a ridge under its rim because the damaged original rim is hidden under a metal mount. But there exists another tell-tale feature that indicates a production by pressing: flat bubbles are present in some beakers, such as the cage cups from Cologne and Munich.[39] The thin wall of the famous Lycurgus cup encloses several flat bubbles, as the participants of this British Museum conference were able to detect for themselves (**Pl. 21**).

Bubbles in a thick-walled vessel tend to float free while the glass is hot and viscous; they are therefore globular or almost

Plate 18 (above) Semi-automatic drawing of the bridge stumps from the diatretum fragment N6211, Römisch-Germanisches Museum, Cologne. The lateral traces of a grinding wheel which 'thinned' the bridges are visible. The biggest stump C is still partly round

Plate 19 (right) Drawing of a cross-cut illustrating Kisa's description of short bridges which end with a round tip under the net

globular in the cold glass. In particular there is no specific force in the hot vessel glass to squeeze a bubble flat against the interior wall (**Pl. 22a**). If a cage cup had been cut from a thick-walled blank, one would expect to see bubbles that were cut open (**Pl. 22b**). But so far none have been recorded.[40] However, as already mentioned above, flattened bubbles are occasionally enclosed in the thin walls of cage cups (**Pl. 22c**). If they occur in a plain vessel, this vessel could have been blown or pressed. Enclosed in the thin parts of a high relief, they are a sure sign of pressing. This is, of course, true for the Lycurgus cup.

The Lycurgus cup is neither a diatretum with applied figures nor was it cut from a pressed double-walled blank. All the figures of this cup, including Ambrosia and the panther (**Pl. 23a–c**), are directly connected to the inner beaker. This rules out the insertion of a perforated mould. How then was this vessel made? The Lycurgus cup's surface provides no hint regarding the manufacturing method. The whole vessel was highly polished.[41] Even the ends of broken limbs and tendrils were polished. This is significant because it means that the polishing took place most likely when the cup was mounted as a chalice in the 19th century, in other words long after its manufacture, but also long before it entered the British Museum.

Looking closely at the cup, one is struck by the softly 'modelled' features of the figures. For instance, Dionysios' hair and headdress are rendered as small protruding convex ribs (**Pl. 23b**). It would be a painstaking task for any cutter of a replica to duplicate these ribs by abrasion because they would require countless tiny facets and a selection of different size cutting wheels.[42] A relief with well rounded convex ribs is usually modelled before being transferred as high relief to a vessel's wall by means of a mould. In conclusion, the flat bubbles inside the Lycurgus cup's wall tell us that the vessel was not cut from a thick-walled blank, but that its production must have included pressing. The soft modelling of certain features, especially the small rounded ribs seen in the figures, is additional evidence that they were pressed as high relief.

The working steps involved in the production of the Lycurgus cup are still related to those for producing a diatretum with applied figures, only this time the figures are not separately prefabricated. They are modelled as crude wax models directly onto the wax model of the cup itself.

Plate 20 The Lycurgus cup in transmitted light, 4th century, ht (with metal mount) 165mm. British Museum, London (PE 1958,1202.1)

Plate 21 Detail showing a flat bubble (middle right) within the wall of the Lycurgus cup

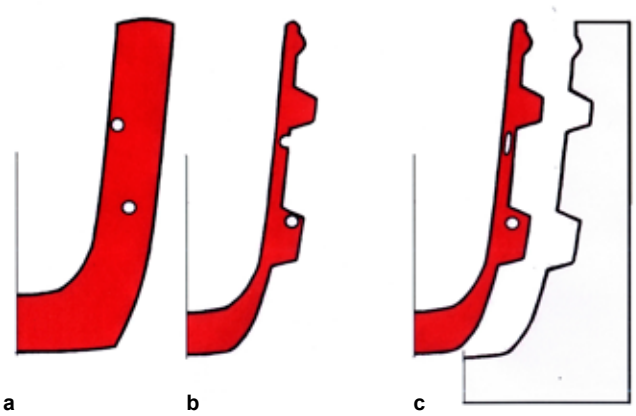


Plate 22a–c a: Bubbles in a thick-walled blank; b: one bubble cut open by relief cutting the thick-walled blank; c: vessel with mould-pressed relief, one bubble squeezed flat

Plate 24 The hypothetical Lycurgus cup mould

Then a plaster mould could be made from the wax model (**Pl. 24**). A vessel pressed into the mould would be decorated with a rough high relief, a detail of which may have looked like **Plate 25**. Subsequently, the limbs and tendrils were separated from the wall by undercutting (**Pl. 26**). Certain facial features and other details were clearly finished by cutting and engraving. This manufacturing method produced slightly more grinding dust than grinding a double-walled blank, but regarding work load and waste, it is still a far cry from cutting a thick-walled blank. In view of the Lycurgus cup's very special glass with its optical effects, economical use of this material would have been an important point of consideration.

The colour change of the cup – depending on whether it is seen in transmitted or in reflected light – underlines its use for lighting. To improve the translucency, the bodies of the main figures were hollowed out from the inside of the vessel (**Pls 27–8**).[43] This may have been accomplished by cutting and grinding, but an examination of the cavities suggests to me that the ancient glass artisans could have figured out a way to realize their goal already during the hot working process. Perhaps they inserted or pressed free floating plaster cores into the reverses of the figures from the inside of the vessel. The same applies to the hollow figures in the lower part of the Lycurgus cup (**Pls 23a–c**, **29**, **30a–b**). It is usually assumed that these were hollowed out by drilling. However, it seems very questionable whether a drill could have been introduced into the open jaw of the panther before its head was broken, and whether the animal's curved body could have been bored with a straight and rigid drill.[44] Here too, the use of plaster cores for both Ambrosia and the panther should be considered. The cores could either have been connected to the mould or separately introduced during the pressing. The use of removable plaster cores

Plate 25 Sketched detail of the roughly pressed high relief

Plate 26 The finished detail

Plate 23a–c Lycurgus cup in reflected light a: satyr and panther; b: Dionysos with detail of head; c: Pan and Ambrosia

Plate 27 The inside of the Lycurgus cup with hollowed out figure of Lycurgus

Plate 28 The inside of the Lycurgus cup in transmitted light with hollowed out figure of Lycurgus

Plate 29 Detail of the hollowed out panther

could explain the absence of drilling traces, and they could also be an explanation for the cavities on the reverses of the fragment in Mainz (**Pl. 1**) and the bird fragment from Athens (**Pl. 2a–b**).

Undercutting and hollowing out rendered the Lycurgus cup walls thin and translucent to let more light shine through the glass. Erika Simon therefore proposed that one should perhaps rather speak about the 'Lycurgus Lamp'. She assumes that it was originally suspended.[45] I have tried to realize her vision – at least virtually (**Pl. 31**).

D: Diatreta cut from a thick-walled blank

The technological observations stimulated by the fragment in Mainz revealed three distinct methods for creating Roman diatreta or their cutting blanks, which could be combined and/or varied in several ways. The basic elements of the technique have their origin in the pressed high relief vessels of the 1st century and their revival in the 3rd century. Technologically the first, and maybe also chronologically the

Plate 30a–b a: The hollowed out panther; b: the hollowed out Ambrosia

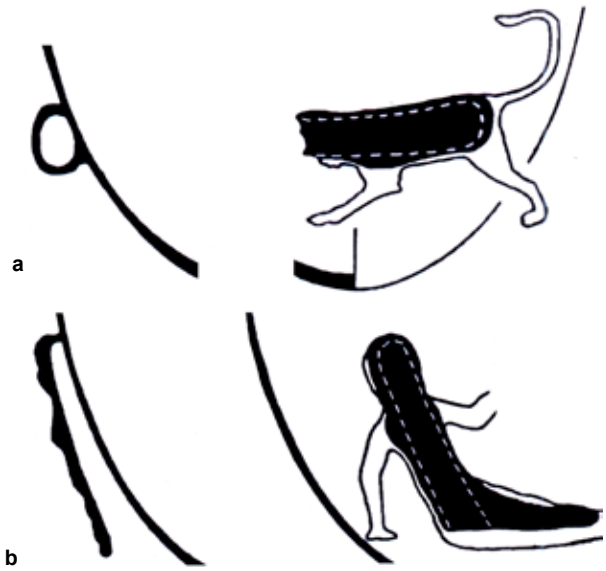


Plate 31 Lycurgus cup mounted as a lamp

Plate 32 Fragmentary bucket from Termantia after its restoration in the Römisch-Germanisches Zentralmuseum, Mainz. The upper rim of the net is an uninterrupted collar, ht 110mm, diam. 204mm. Museo Arqueológico Nacional, Madrid (no. 21529)

first diatreta (A) are vessels like the Pharos beaker which are decorated with separately prepared elements joined to a pressed vessel. The bridges and socles holding the appliqués are pressed simultaneously with and from the vessel wall. These vessels required very little cutting and carving. Second are the true cage cups (B) which were cut from double-walled blanks: either the cage cups with figural decoration like the cup from Varese or the network cage cups with a geometrical net. Again, the bridges and socles were pressed simultaneously with and from the vessel wall – the inner shell – to the outer shell which was subsequently cut open to form the decorative cage. A little bit more cutting and engraving was necessary to finish these cage cups. The third method is exemplified by the Lycurgus cup (C) which appears to have been made by undercutting and engraving a strongly protruding pressed high relief. Here a more substantial but still limited cutting job was required.[46]

There seems to be a chronological order in the increasingly applied amount of abrasion. One could assume that as a late logical step of this development, the making (D) of a diatretum by cutting from a thick-walled, pressed or blown blank was possible – without any hot preparation of this blank by mould pressing or a special outer shell. According to the German archaeologist Thea Elisabeth Haevernick, two diatreta already correspond to this description.[47] With regards to the fragmentary bucket from Termantia (**Pl. 32**)[48] and the situla from San Marco in Venice, [49] she remarked: 'Both vessels in any case have in common that they were cut from a full, that means thick-walled blank. By holding these vessels in the hand, it becomes clear that this was possible, because here indeed one holds a mass in one's hand which could be worked. It is a very big difference to the well-known Roman diatreta.'[50] Both vessels have a distinct bucket shape which differs from the bell shape of the majority of cage cups and which is therefore not favourably adapted to double-shell pressing. Nevertheless, there were still doubts whether the two ancient diatreta really were made in a different technique. As has been mentioned before, cutting a cage cup from a thick-walled blank was a very risky task because of the problems of stress-free cooling in antiquity.

A publication that appeared after the British Museum conference banished all doubts.[51] The fragments of a cage cup were found in Grenoble. The manufacturing traces of these fragments differ considerably from those mentioned for instance here in Section B. The fragments are thick-walled and their surfaces show traces of cutting and grinding all over – no doubt, this cage cup was cut from a thick-walled blank. Assumedly, it was broken during manufacture, which could easily be explained by the expected stress problems. One of the fragments preserved the rim of the net. This rim here is an uninterrupted collar and not a ring supported by bridges as seen in other cage cups.[52] A closer look at the Termantia bucket reveals a similar feature: the rim of the net is an uninterrupted collar (**Pl. 32**). There is also one more similarity. For the well-known Roman cage cups, the cross sections of the net's meshes as a rule become wider towards their reverses.[53] This feature is in accordance with the production by cutting a double-walled blank because only in this way would an acute angle between the side and the reverse of the mesh be automatically generated. But the meshes of the fragmentary bucket from Termantia, and seemingly also of the cage cup fragments from Grenoble,[54] instead predominantly show a slight narrowing towards the reverse. The 'very big difference' between the two ancient buckets and the Roman diatreta mentioned by Haevernick, is also true for the cage cup from Grenoble. It is based on its different manufacturing process: the cutting from a thick-walled blank. This process may indicate a later date of production. The problematic annealing process may now have been better controlled. Haevernick mentions the possibility that the buckets from Termantia and San Marco could perhaps be Byzantine (from about the 5th century), and the fragments from Grenoble were found – according to Renée Colardelle[55] – in a mound above the Late Antique street level. This may hint at a similar dating. In any case, cutting a cage cup from a thick-walled blank was a technological progress, but it remained a risky task. It may be that not many examples were made; so far only the two buckets and the recently found fragments from Grenoble are known.

Conclusion

Cutting a diatretum or cage cup from an elaborately pressed blank seems to be a smart and efficient shortcut compared with the artistic dexterity of making such a marvel by cutting a thick-walled blank. But this is not quite true. The production of a double-walled blank required the work of gifted artists and technicians for the precise preparation of models, moulds and tools, and it needed expert execution. For the artful model the difficulties of the glass manufacturing process had to be assessed. Mould and plunger sizes had to be perfectly adapted to guarantee exact wall thickness. The moisture content of moulds and tools, the viscosity and temperature of the glass, the alignment of moulds and plungers, as well as the speed of turning, tooling and cooling, all these details had to be controlled within narrow limits. The production of the blank really required an expert team to be successful. The final cutting remained a risky and laborious task, but because of the skilfully pressed blank, it was manageable with the means available in Roman times. The masterly preparation of the cutting blank was the indispensable precondition for creating a diatretum.

There is no doubt that the *diatretarii* or diatreta cutters were exceptional artisans, but they were still 'normal' glass cutters. Josef Welzel once stated: 'The art of cutting and engraving glass of the 4th century is primitively executed and does not show great skill.'[56] There are numerous examples to prove the truth of this statement.[57] It is difficult to believe that superior gem cutters applied their skill to cage cups but did not care about any other cut glass object. Glass is a different and difficult material for gem cutters. It cannot be three-dimensionally micro-chipped as easily as stone.[58] Cracking due to stress is an ever present danger before or during any abrasive treatment of glass. In reality, the primitive cutting seen on diatreta meshes and shanks is in perfect agreement with the poor quality and low standard of the art of glass cutting of the 4th century. The shanks of a diatretum are usually partly thick and partly thin, sometimes crooked, partly still round or almost cut through.[59] One should remember the drawing of the shank stumps with circular cutting traces (**Pl. 18**). It is not convincing to assume that the artisans who cut the shanks were able to cut the internal beaker of a cage cup with its often perfectly smooth surface and average wall thickness of about 1–2mm (sometimes less than 1mm)[60] from a thick-walled blank. These thin vessel walls must have been made by pressing. This is supported by the fact that some beakers show hardly any traces of cutting, by the occasional occurrence of flat bubbles, by the frequent occurrence of protruding ridges under the rim, and last but not least, by the horizontal rotary scratches seen on the interior of many vessels – a feature not known from blown glass, but easily explained by rotary pressing.[61]

Many questions still remain. The feasibility of the most important working stages of the proposed manufacturing techniques was successfully tested with the materials and equipment available in glass workshops today,[62] but an experimental reproduction under close to original conditions could not be attempted. A precondition would have been basic research into the production and use of the ancient raw glass,[63] as well as of the mould materials,[64] and the tools and firing equipment. A trustworthy revival of the forgotten technique with its complex methods and workshop secrets would be a challenge even for a specialized team with the necessary resources, localities, and time – all of which are far out of reach for a private individual.

On the other hand, individual gifted artists have been able today to produce cage cups with modern methods, tools, and abrasives in the privacy of their home or workshop. They have cut delicate thin-walled cage cups from thick-walled blanks which of course were stress and bubble free. The perfect beauty of these cage cups deserves our utmost admiration. Replicas of vessels based on fragments also have great scientific merit. But as is to be expected, the significant bubbles, scratches and irregularities of the Roman originals are missing. One can only learn something about the original manufacturing technique by studying the manufacturing traces shown by the originals. They remain our sole reliable guide.

In short, the following features indicating the use of laboriously prepared, complex cutting blanks were discussed in this paper: the absence of traces of cutting or grinding on the exterior wall of some cage cup beakers; the absence of traces of cutting or grinding on the reverses of some figures and net meshes; round or partly round shanks; crudely cut shanks and net meshes; Kisa's round-tipped shanks which do not touch the net; shanks homogeneously connected to the vessel wall; the typical protruding ridges under the rim; the absence of bubbles which were cut open; the occurrence of flat bubbles in thin vessel walls; and thin-walled cups which cannot be explained as products of cutting and grinding in a time when glass cutters obviously still had problems with their art. Less waste of material and the necessity of a liability exemption are additional considerations. The typical horizontal scratches on the inside of most cage cups, a feature appearing similarly on rotary pressed glass vessels from the 5th century BC until about the 1st century AD and re-appearing in the 3rd and 4th centuries, was touched on only marginally.[65]

Notes

1 This essay is dedicated to the memory of Thea Elisabeth Haevernick (1899–1982). I am very grateful to Christian Eckmann, Björn Gesemann and Volker Iserhardt of the Römisch-Germanisches Zentralmuseum, Mainz for providing the fragment from Mainz for investigation, for bibliographic research and for terrific photographs; Marianne Tazlari and Barbara Benz, Glasmuseum Wertheim for making the tiny cage cup fragment of the Haevernick collection available for investigation and photography; to Sabine Faust and Annegret Gerick, Rheinisches Landesmuseum Trier for valuable information and permission to publish objects in their care. I am also grateful for the kind permission to reproduce photographs to: N. Benassi, Procuratoria di San Marco, Venice; P. Cambon, Musée Guimet, Paris; A. Szabo, Hungarian National Museum, Budapest; to the staff of the National Archaeological Museum Athens, Museum Het Valkhof, Nijmegen and Museo Civico Archaeologico di Villa Mirabello di Varese. My special thanks go to Chris Entwistle and Liz James for their invitation. Without them, this paper would not have been written. I also thank my friends Shari and David Hopper for reading and improving my English draft, and to Marianne Stern, Chris Entwistle and Sarah Faulks for substantially improving its final appearance. Naturally, I take responsibility for any remaining errors or mistakes.

2 D.B. Harden and J.M.C. Toynbee, 'The Rothschild Lycurgus cup', *Archaeologia* 97 (1959), 179–212, esp. 207.
3 G.D. Weinberg and E.M. Stern, *Athenian Agora XXXIV: Vessel Glass from the Athenian Agora*, Athens, 2009, no. 174, ills 16 and 18.
4 This observation was confirmed by E.M. Stern during the discussion at the British Museum conference in London, 28 May 2010.
5 A. Koster and D. Whitehouse, 'Early Roman cage cups', *Journal of Glass Studies* 31 (1989), 25–33.
6 P. Hamelin, 'Matériaux pour servir à l'étude des verreries de Bégram', *Cahiers de Byrsa* 4 (1954), 153–83, esp. 174; M. Menninger, *Untersuchungen zu den Gläsern und Gipsabgüssen aus dem Fund von Begram (Afghanistan)*, Würzburg, 1996, pl. 13, 3–5.
7 L. Pirzio Biroli Stefanelli, 'Beaker with plant sprays', in D.B. Harden *et al.*, *Glass of the Caesars* (exh. cat., Milan), Milan, 1987, no. 100.
8 See R. Lierke, *Die nicht-geblasenen antiken Glasgefäße/The Non-blown Ancient Glass Vessels* (Deutsche Glastechnische Gesellschaft), Offenbach/Main, 2009, 8, for an example of a temperature controlled cooling cycle which is necessary for optimal stress-free cooling after hot manufacture.
9 Examples of 1st and 3rd centuries pressed high relief are usually mentioned in the literature as high relief cut glass. For a different view and examples see: R. Lierke *et al.*, *Antike Glastöpferei – ein vergessenes Kapitel der Glasgeschichte*, Mainz, 1999, 101, 105–7.
10 The only known intact example is the Hunting Bowl from Stein am Rhein: H. Urner-Astholz, *Die römische Jagdschale und eine Kugelschliffschale von Stein am Rhein* (Separatdruck aus Schaffhauser Beiträge zur Geschichte, H. 51), Thayngen, 1974; W.U. Guyan, 'Die Jagdschale', *Helvetia Archaeologica* 6 (1975), 61–77; Lierke (n. 9), pl. 167. Another example would be the top part of the fragment of **Pl. 18**: J. Röder, 'Die Diatretglasscherbe N 6211 des Römisch-Germanischen Museums in Köln', *Kölner Jahrbuch* 6 (1962/3), 98–106, pl. 12.
11 E.M. Stern, 'Glass working before glass blowing', *Annales du 12th Congrès de l'Association Internationale pour l'Histoire du Verre Vienna 26–31 August 1991*, AIHV, Amsterdam, 1993, 21–31.
12 Besides moisture, plaster contains water in its crystal structure. The loss of the crystal-bound water through heat causes the plaster to lose its stability. For some simple experiments with high relief using plaster moulds see Lierke (n. 9), 102–3.
13 For numerous examples of vessel types with ridges (not including applied threads) see J. Hackin and O. Kurz, 'Verre', in *Nouvelles recherches archéologiques à Begram. Mémoires de la délégation archéologique française en Afghanistan*, vol. XI, Paris, 1954, figs. 252, 254, 255, 257–62, 265, 359–63, 364–6; Menninger (n. 6), pl.12 / 2, 3, pl.13 / 1?, 3, 4 pl. 15 / 1, 2, pl.16 / 1, pl.20 / 2, pl.26 / 1–4, pl. 27 / 1; or Harden (n. 7), 22, 23, 35, 99, 100, 104?, 105, 108?, 109, 134–7. The pressed-on bottoms are often accompanied by a collar or ring, which precludes manufacture by blowing. Frequently the bottom shows a central circular protrusion instead of the pontil mark of late 1st-century blown vessels. Early closed vessels with ridges seem to be related to non-blown (pressed and sagged) vessels dated predominantly to the 1st century BC/AD.
14 Koster and Whitehouse (n. 5), 14.
15 P. Hamelin, 'Matériaux pour servir a l'étude des verreries de Bégram', *Cahiers de Byrsa* 3 (1953), 121–8, pl. VI; Menninger (n. 6), pl. 13/4–5.
16 Hamelin (n. 6), 174, pl. XXXVII; Menninger (n. 6), pl. 13/3.
17 O. Doppelfeld, 'Der neue Kölner Konchilienbecher', *Festschrift für W. Haberey*, Mainz, 1976, 23–8; H. Hellenkemper, 'Becher mit Meerestieren', in Harden *et al.* (n. 7), no. 144. According to A. Kisa, *Das Glas im Altertume*, 3 vols, Leipzig, 1908, vol. III, 769, the Conchylien beaker in Trier was blown; blowing was confirmed by personal observation also for the vessels in Cologne and the Vatican. Doppelfeld (ibid.) does not mention the production method. Hellenkemper (ibid.) writes 'in einer nassen Holzform gegossen' (cast in a moist wooden mould), which would be problematic.
18 Hellenkemper ibid., 254; K. Goethert-Polaschek, *Katalog der römischen Gläser des Rheinischen Landesmuseums Trier*, Trier, 1977, no. 241.
19 A clay shell could also secure the plaster mould through later working steps.
20 L. Barkóczi, *Pannonische Glasfunde in Ungarn* (Stud. Arch. 9), Budapest, 1988, no. 556.
21 W.F. Volbach, 'Opere antiche, tardo antiche e proto-bizantine', in H.R. Hahnloser (ed.), *Il Tesoro di San Marco* II, Florence, 1971, no. 8, 7–8, pl. IV.
22 Personal observation.
23 Koster and Whitehouse (n. 5), 28, 29, pls 4–6; Menninger (n. 6), 77–83, pl. 26, figs 3, 4.
24 Koster and Whitehouse (n. 5), 30.
25 M. Bertolone, 'La tazza vitrea diatreta Cagnola', *Rivista archeologia antico Provincia di Como* 128/29 (1947/48), 31–40; G.M. Fachini, 'The Cagnola Cage Cup', in Harden *et al.* (n. 7), no. 137.
26 The basic principle of this theory has been experimentally verified with the mould and glass material available in a modern glass workshop. The pressing requires a controlled amount of humidity within the plaster moulds to create temporarily a thin layer of steam between the glass and the moulds. This also enables the release of trapped air. For the first improvised experiments see R. Lierke, 'Vasa diatreta Teil II', *Antike Welt* 26(4) (1995), 251–69, esp. 261; Lierke, (n. 9), 124.
27 Goethert-Polaschek (n. 18), no. 238.
28 A. Gerick, 'Die Trierer Diatrete und die Frage nach der Herstellung römischer Netzgläser', *Restaurierung und Archäologie* 3 (2010), 117–36, with several illustrations.
29 Ulpian, *Ad Edictum Praetoris*, lib. 18, Dig. 9, 2, 27 §29 (*c.* AD 200–50).
30 H. Eiden, 'Diatretglas aus einer spätrömischen Begräbnisstätte in Niederemmel an der Mosel', W. Reusch (ed.), *Aus der Schatzkammer des antiken Trier*, Trier, 1950, did not recognize any traces of cutting or grinding on the beaker surface, while Gerick (n. 28) found some. The following examples are without noticeable traces: the diatretum from Hohensülzen according to Kisa (n. 17), vol. II, 621–2; the fish diatretum in Budapest (my own observation); and, most likely, the Pharos beaker, and the Cagnola cup.
31 Gerick (n. 28), 133, mentions the absence of noticeable traces of cutting or grinding on the reverses of meshes for five out of the six examples from Trier. The reverse of the leaf fragment from Athens should also be mentioned here, see **Pl. 2c**.
32 D. Whitehouse, 'A recently discovered cage cup', *Journal of Glass Studies* 30 (1988), 28–33; Lierke 1995 (n. 26), 253; C. Steckner, 'Diatrete als Lichtgefäße', in Lierke *et al.* (n. 9), 110–14.
33 Röder (n. 10), fig. 1.
34 Gerick (n. 28), 133, mentions partly round shanks with round shank bases (!) for three examples (the shanks of two of the six Trier cage cups are not preserved).
35 Kisa (n. 17), vol. II, 621–2.
36 H. Hannes, 'Optische Untersuchungen am Diatretglas', *Technische Beiträge zur Archäologie* I (1959), 78–80; R.H. Brill, 'An observation on the Corinth Diatretum', *Journal of Glass Studies* 6 (1964), 56–8.
37 Hannes ibid., detected some strain at the transition from wall to shank which is hard to explain by the cutting theory, but it may be explained by the different temperature or speed of heat transfer the hot glass is exposed to at the first contact with the mould material or the air in the perforation.
38 Harden and Toynbee (n. 2); K. Painter, 'The Lycurgus cup', in Harden *et al.* (n. 7), no. 139; H. Tait, *Five Thousand Years of Glass*, 1991, 91–4.
39 Lierke *et al.* (n. 9), fig. 279; Lierke (n. 8), 80; for another example, see Gerick (n. 28), 121.
40 For a hole in the Lycurgus cup panther see n. 44. The small shallow circular depressions frequently seen in the surface of cage cups and other ancient glass vessels are usually due to corrosion caused by severe weathering (*Lochfraß* in German).
41 Harden and Toynbee (n. 2), 187; G.D. Scott, 'A study of the Lycurgus cup', *Journal of Glass Studies* 37 (1995), 51–64. The drastic polishing led Harden to assume that the vessel had been fire polished: Harden and Toynbee (n. 2). He still maintained this argument in Harden *et al.* (n. 7), 249; Scott ibid., assumed that the ubiquitous polishing marks were evidence for cutting from a thick-walled blank. For a different view see R. Lierke, 'More on the Lycurgus cup', *Journal of Glass Studies* 38 (1996), 276–7.
42 It is no surprise that these ribs were replaced by cut grooves in the Lycurgus cup replica by Welzel (J. Welzel, *Becher aus Flechtwerk von Kristall*, Glasmuseum Wertheim, 1994, fig. 34). As an accomplished

artist, Welzel usually added a personal touch to his early replicas. In this case, it may have saved him a large percentage of the cutting time. It is interesting to note that Franz Gondelach, the pioneer of early 18th-century Hochschnitt, used high relief pressed blanks for his high relief cut glasses (F.A. Dreier, 'Franz Gondelach: Baroque glass engraving in Hesse', *Journal of Glass Studies* 38 (1996), 11–228, esp. 56–9). This procedure is still in use today.

43 D.B. Harden, 'The Rothschild Lycurgus cup: addenda and corrigenda', *Journal of Glass Studies* 5 (1963), 9–17, fig. 8.

44 A hole located precisely in one of the deepened (obviously engraved) panther spots where the wall was especially thin was probably caused by heavy polishing in modern times.

45 Personal communication. The use of cage cups and other ancient glasses, including *Konchilienbecher* as lamps was treated by Cornelius Steckner and R. Lierke in Lierke *et al.* (n. 9), 109–17. According to Steckner, the glasses were lit with a floating wick in a layer of oil on a cooling liquid like water or red wine.

46 Marianne Stern also discussed the development of cage cups with the aid of improved cutting equipment and she mentioned the possibility of making a cage cup by mould-pressing and undercutting (Weinberg and Stern (n. 3), 91).

47 T.E. Haevernick did not support Fremersdorf's cutting theory for the well-known Roman diatreta. Her vague idea of using a wooden support during the manufacturing of the cutting blank inspired my manufacturing theory of using a perforated plaster mould: Lierke *et al.* (n. 9), 121.

48 T.E. Haevernick. 'Zu dem Diatret von Termantia', *Madrider Mitteilungen* 12 (1971), 202–4; also published in T.E. Haevernick, *Beiträge zur Glasforschung*, Mainz, 1981, 211–14.

49 Volbach (n. 21), 10–11, no. 13. J. Welzel, 'Die Situla im Domschatz von San Marco in Venedig', *Kölner Jahrbuch* 35 (2002), 91–407. Welzel found several features to support the cutting from a thick-walled blank which, however, he assumed to be the manufacturing method for all cage cups.

50 Haevernick (n. 48): 'Beiden Gläsern ist unbedingt gemeinsam, dass sie aus dem Vollen, also einem dickwandigen Rohling ausgeschliffen sind. Wenn man diese Gläser in der Hand hat, leuchtet es auch ein, daß das möglich war, denn hier hat man in der Tat eine Masse in der Hand, die sich bearbeiten lässt. Es ist ein sehr großer Unterschied zu den bekannten römischen Diatreten.' (English translation by the author.)

51 M. Kappes, 'Les fragments d'un verre diatrète de Grenoble. Eléments technologiques', *Journal of Glass Studies* 53 (2011), 93–101; R. Colardelle, *La ville et la mort. Saint-Laurent de Grenoble, 2000 ans de tradition funéraire* (Bibliothèque de l'Antiquité Tardive, BAT 11), Turnhout, 2008, (relevant: 3rd phase of excavation 102–17, esp. 114–17); R. Lierke, 'Manufacturing marks and the persuasive power of replicas', *Annales de 19e Congrès de l'Association Internationale pour l'Histoire du Verre*, Piran, 2012, in print.

52 Kappes (n. 51), figs 8.1, 2; *cf.* **Pls 13**, **15a–c**.

53 See for example ibid., fig. 1, showing a detail of the cage cup from Koeln-Braunsfeld; more examples are mentioned in Gerick (n. 28), 121–2, 129, 134.

54 Kappes (n. 51), fig. 12.2.

55 Colardelle (n. 51).

56 J. Welzel: 'Die Glasschliff- und Gravurarbeiten des 4. Jahrhunderts sind primitiv ausgeführt und …deuten auf kein großes Können'. From J. Welzel, 'Schleiftechnik der Diatretgläser', *Glastechnische Berichte* 51(5) (1978), 130–6. (English translation by the author.)

57 Numerous examples are illustrated in Harden *et al.* (n. 7). See also F. Fremersdorf, *Die römischen Gläser mit Schliff, Bemalung und Goldauflagen aus Köln* (Die Denkmäler des römischen Köln, vol. 8), Cologne, 1967.

58 A method used for example to carve stone cylinder seals, first described in M. Sax and N.D. Meeks, 'Methods of engraving Mesopotamian quartz cylinder seals', *Archaeometry* 37/1 (1995), 25–36.

59 For instance, see Gerick (n. 28), 129, 133. For a crooked shank see: *Fundstücke. Von der Urgeschichte bis zur Neuzeit* (Rheinisches Landesmuseum Trier), Stuttgart, 2009, 137.

60 Gerick (n. 28), 121, 123, 128.

61 Examples of rotary scratches: Lierke *et al.* (n. 9), 80, 118 (n. 143), fig. 290; Gerick (n. 28), mentions rotary scratches on the cage cups from Trier Nikolausstrasse, Basilika and Niederemmel.

62 Improvized experiments concerning cage cups, mainly verifying the possibility of pressing double-walled blanks, took place in the workshops of Pavel Molnar, Hamburg, H.J. & K.H. Ittig, Wertheim, and the Bildwerk, Frauenau. They were partly supported by a grant of the Deutsche Forschungsgemeinschaft (DFG).

63 This determines the working properties of the glass. The insertion of a differently coloured chunk in the wall of the Lycurgus cup (first noticed in Scott (n. 41)) is evidence that it was made with reheated chunks of raw glass.

64 For example, ancient gypsum plaster comes from natural resources. It greatly differs in its consistency and homogeneity, both influencing its properties as a mould material and its heat resistance. Other materials beside gypsum plaster could have been used as a mould material, for instance a mixture with quartz powder.

65 Concerning the erroneous explanation of these scratches as grinding marks see: R. Lierke, 'Auf den Spuren der Amphora', *Restaurierung und Archäologie* 2 (2009), 67–80 (for an English translation see: www.rosemarie-lierke.de); Lierke (n. 8), 73–88.

Chapter 12
The Lycurgus Cup

Jaś Elsner

The Lycurgus cup, generally dated to the 4th century, is the most spectacular cage-cup surviving from antiquity.[1] It is made from glass of the normal Roman soda-silica-lime variety to which about 40 parts per million of gold and 300 parts per million of silver were added.[2] This addition of precious metal, as well as a smaller proportion of manganese in a particular form resulting in sub-microscopic crystals or colloids of the metals, appears to be chemically responsible for the very special optical qualities of the vase, which is opaque jade green in reflected daylight but turns a translucent wine-red in transmitted light (see **Pls 1–12**).[3] The vase is the result of an exceptionally complex technical process that created a cunningly pressed basic form, as with other diatreta, which was cast cut back with consummate – indeed, frankly spectacular – skill, to create a frieze in high relief, frequently undercut (**Pl. 13**).[4] The surfaces of the cup have been exceptionally preserved and there are a number of remarkable features, such as the hollowing out and light polishing of the profiles (head and body) of the four standing figures on the interior of the vessel (as well as their cutting on the exterior), which emphasizes their radiance in transmitted light (**Pls 14–15**).

The cup's subject matter is the myth of Lycurgus,[5] already recounted in Homer's *Iliad* (6.130–40), but in a form that seems to follow closely the version known from Nonnos of Panopolis, who was writing roughly in the period when the cup was made at the end of the 4th or first half of the 5th century.[6] Nonnos describes Lycurgus as a son of Ares and Thracian king, who persecuted Dionysios and drove him into the sea. He then attacked the maenads in the god's

Plate 1 The Lycurgus cup: detail with Dionysios, opaque jade green. 4th century. British Museum, London (PE 1958,1202.1)

Plate 2 The Lycurgus cup: detail with Dionysios, translucent wine-red

Plate 3 The Lycurgus cup: detail with Pan, panther and Dionysios, opaque jade green

Plate 4 The Lycurgus cup: detail with Pan, panther and Dionysios, translucent wine-red

Plate 5 The Lycurgus cup: detail with Pan, panther and Dionysios, opaque jade green

retinue, but after a fight with the nymph Ambrosia, she prayed to the Earth to save her (**Pls 9**–**10**). The Earth seized her in an embrace and as she disappeared, she turned into a vine-shoot, which coiled itself around Lycurgus entangling him in a Dionysiac snare (**Pls 7**–**8**), while the throng of Dionysios' entourage surrounded and tormented him (**Pls 5**, **6**, **11** and **12**). The cup shows Lycurgus entwined, with Ambrosia to his right on the ground beneath a satyr who attacks the king with a stone. To Lycurgus' left is Pan with a panther and behind Pan, on the opposite side of the cup to Lycurgus, is Dionysios himself (**Pls 1**–**2**).[7]

Nothing is known of the context in which the cup would have been used, although most people (including me below) would argue for some kind of banqueting setting – a fitting scene for its Dionysiac imagery. It is however worth briefly reviewing the alternative options, none of which is impossible although most scholars would hazard that they are less plausible. David Whitehouse has suggested that the

Plate 6 The Lycurgus cup: detail with Pan, panther and Dionysios, translucent wine-red

Plate 7 The Lycurgus cup: detail with Lycurgus trapped by vine branches, opaque jade green

Plate 8 The Lycurgus cup: detail with Lycurgus trapped by vine branches, translucent wine-red

Plate 9 The Lycurgus cup: detail with satyr, Ambrosia and Lycurgus, opaque jade green

cup might have had a Dionysiac cult function 'in ceremonies and feasts in honour of Dionysios'.[8] This is not impossible at all. If we pushed the Nonnos connection, noting the author's Christian faith (he wrote a verse paraphrase of the Gospel of John as well as the *Dionysiaca*), we might be looking at a Christianized polytheism in an object like the cup.[9] This has mileage if one thinks of its two natures (green and red) in one substance (a glass cup), and see it playing in a light-hearted way (perhaps in a sympotic context) with the kinds of Christian theological thinking so prevalent in the 4th century, as described by Gregory of Nyssa who tells how in the AD 380s, one could not go into a food or clothes shop without having to discuss the Begotten and the Unbegotten, the relations of Father and Son.[10] Again this is not impossible, but perhaps somewhat far fetched. Neither of these views – both springing from the cup's iconography and its potentially religious implications – is necessarily exclusive of a primarily sympotic interpretation. A final intriguing

Plate 10 The Lycurgus cup: detail with satyr, Ambrosia and Lycurgus, translucent wine-red

Plate 11 The Lycurgus cup: detail with satyr, opaque jade green

Plate 12 The Lycurgus cup: detail with satyr, translucent wine-red

Plate 13 The Lycurgus cup: detail of hollow body of panther, opaque jade green

option, which would find greater support if we could identify the cup's provenance (another great unknown) as Egyptian, concerns the evidence that exists for a late ancient cult of Lycurgus. One of the most exciting areas of current research in Late Antiquity is the large number of unpublished pre-Christian votive and cult panel paintings mainly from Egypt which are currently being collected into a corpus by Vincent Rondot and Thomas Mathews. A group of these from Fayoum represent a bearded deity with a double-headed axe similar to the one Lycurgus is busy dropping in the relief on the cup. Rondot has identified these (as well as some sculptures of the Coptic period) as images of Lycurgus as a deity in Late Roman Egypt, and has included the cup in the orbit of this material.[11] This would make the cup a kind of liturgical object in a very particular and rather rare kind of cult, something like a chalice in contemporary Christian

Plate 14 The Lycurgus cup: detail of the hollowed out back of Lycurgus' body

Plate 15 The Lycurgus cup: interior shot of the reverse of Lycurgus' body

culture. However, I think this suggestion is a long shot, and not top of the list of likely contexts.

The interesting evidence for the use of diatreta glasses (in which class the Lycurgus cup certainly belongs) as lamps in Late Antiquity,[12] may help to explain the experimental play with its material which gave rise to the dichromatic type of glass that it shares with a few surviving fragments with similar properties.[13] It seems that there is little doubt that the Lycurgus cup was originally made to be an accoutrement of the symposium. This is supported by the explicit Dionysiac subject matter of its iconography (effectively referring ironically to the dangers of drink and of spurning the god of wine), its dichroic nature in evoking through its two colours not only red and green grapes but also red and white wine, and by the publication of what remains of its base (only possible after the British Museum purchased the cup from Lord Rothschild in 1958) which seems to me strongly to support the object's form (if not certainly its function) as a drinking cup.[14] It is not impossible that it was intended to be used as a lamp to light a dinner party rather than a drinking cup, although I would still incline towards it functioning as a cup.[15]

The sympotic context – where the cup, whether as a lamp or as a drinking vessel – commented on and played with the social circumstances of its use and function, is of course typical of Dionysiac imagery stretching back over 1000 years to the Greek painted pottery of the 6th and 5th centuries BC (e.g. **Pl. 16**). In this circumstance, it warns dinner party drinkers of both the risks of alcohol – the maddening process whereby Dionysios' retinue can kill and torture when under the influence – and the equal risks in disdaining the power of the vine and the ecstatic (and in this case supernatural) effects of Dionysios' power. How best the cup – and one might imagine a set of others like it in the same material being used at an elite occasion – would work in this context is not clear. Despite the indepth analyses of its nanotechnology (and this has become the ultimate object for the application of nerdy scientism to antiquity), no one has asked how its light effects respond to it being filled with wine, water or (if it were to be a lamp) oil, nor how it would resist the heat of a lit wick resting in the oil. It is hard to imagine it being used in such a context, but instead it is more likely that it was passed round the dinner table or admired at its centre for its wonderful skill and spectacular lighting effects.

It is a striking aspect of Late Antique fitments and accoutrements to a number of social and religious ritual contexts that their iconography – be it mythical or an idealized rendering of daily life – is often highly reflexive, commenting on the kind of situation it accompanies. One thinks of the Projecta casket and its insistent imagery of adornment and bathing (in both the mythological sphere and that of idealized 'real life', **Pl. 17**),[16] of dining silver such as Sevso's hunting plate, which depicts the act of dining,[17] or of such wonderful pieces as the 5th-century bronze lamp from a basilica in Africa that is itself shaped as if it were a basilica.[18] Here the Lycurgus cup clearly fits well into its general context, and indeed one wonders whether part of its play on sympotic vessels does not include a game with the kind of repoussé silverware that must have been used frequently in feasting contexts. Its relatively dull green colour in the artificial light of a symposium would not have been so far from the relative darkness of silver (especially if tarnished after a bit of use) and the impressive cutting of the interior of the blank to hollow out the standing figures does of course evoke the effects of repoussé silver work, where the original silver is hammered on a mould to fashion the up-raised decoration on the front, leaving the back to show the reverse of the exterior decoration (**Pl. 18**). The effect of

Plate 16 Red-figured kylix depicting a symposium on its exterior, 485–480 BC. British Museum, London (GR 1843,1103.15)

Plate 17 The Projecta casket: detail with Venus bathing, late 4th century. British Museum, London (PE 1866,1229.1)

Plate 18 The Projecta casket: details showing the interior of the casket with repoussé figures

such 'imitation' – if that is what it is – would be to allow a brilliant reversal when the effects of transmitted light were demonstrated. If the cup is a drinking vessel, then the depressions of the interior reveal a shift away from smooth surface interiors in luxury drinking cups in the early empire to a willingness to live with repoussé hollows and the kinds of interior effects found in the Lycurgus cup in Late Antiquity.[19]

At the same time, the keenness of modern scholarship to prove that the material of which the cup is made is glass and its enthusiasm for finding all kinds of nanotechnological wonders in the Lycurgus cup,[20] ought not to blind us to the interesting uncertainties expressed by various experts, who did not have access to complex scientific testing, as the cup was then in private hands when the object was first published.[21] That is, the cup is made from an odd kind of glass with extremely unusual properties. These may well have allowed it to be taken in antiquity for being something much more precious than glass – like the gems with spectacular lighting effects described in loving detail (and rather difficult Greek) in the recently discovered and newly published *Lithika* of the 3rd-century BC Hellenistic poet, Posidippus of Pella. It could also have been seen in the same light as the precious bowl made literally of 'glass dug out of the ground' (ὑάλου... ὀρωρυγμένης) which is perhaps meant to mean crystal, an item that is green when empty but gradually becomes red when filled with wine, which is mentioned by Achilles Tatius in his 2nd-century novel *Leucippe and Clitophon* (II.3.1–2).[22] Achilles Tatius' cup is Dionysiac in theme and has the god explicitly represented on it, as with the Lycurgus cup.

It is worth dwelling a little on Posidippus as this is new material (the papyrus was only published in 2001[23] with translations appearing in 2002 and 2005[24]) and it offers a new insight into discussions of the Lycurgus cup. The book – written down as a papyrus roll around 230–200 BC – is a compendium of over 100 epigrams (some very fragmentary indeed) collected in antiquity and grouped by themes, such as omens, dedications, statues and so forth. The first group of 20 poems concerns stones, especially gems,[25] and has numerous references to the special effects of such jewels in light.[26] For instance in poem 16, the poet celebrates a rock crystal, described with the adjective πολιός (meaning 'grey' but also 'radiant' or 'clear') whose translucence (τὸ διαυγὲς) is 'precious as the beauty of the sun' (τὸν πολιὸν κρύσταλλον...τὸ διαυγὲς ἂν αὐτοῦ/τίμιον ἦν ὥσπερ καὶ καλὸς ἠέλιος). The Posidippus material is undoubtedly courtly,[27] and in part relates to royal banquets (notably poems 2, 3 and 18).[28] Poem 3 describes a gem (restored by the editors as a ruby) which has either had a drinking cup incised on it,[29] or, more importantly for this discussion, had been carved into a drinking cup decorated with flowers and tendrils (to go along with the 'drinking horn' or rhyton of poem 2).[30] The Greek is entirely ambiguous about these different interpretations since it simply speaks of a shining gem 'in which' (ἐν ᾧ) a phiale (drinking cup) has been cut. However, the sympotic context of the object, whether an

Plate 19 Sard scaraboid stamp seal with a horseman chasing a chariot, Greek, 4th century BC. British Museum, London (GR 1911,0415.1)

actual cup or a gem with a carved cup, is certainly close to that of the Lycurgus cup.

Poem 8 begins with a remarkable puzzle in which the poem's meaning deliberately mirrors the raw material of its supposed referent by conveying in verse some of the intricate visual complexities of carved gems or, in other words, by shifting its apparent meanings as a jewel's sparkle changes with the light. Like those mentioned in poems 4–7, the gem in Poem 8 is attached to a golden chain (v.2). When the light shines from below (φέγγος ἔνερθεν ἄγων, v.5) this beautiful stone with an image of Darius (Δαρεῖον φορέων ὁ καλὸς λίθος, v.3) shows an engraved chariot (ἅρμα ... γλυΦθέν, vv.3–4) (see **Pl. 19** for a Graeco-Persian gem of the 4th century BC with the same iconography). On the other hand, when the light shines with equal strength from all around (αὐγαῖς ἐξ ὁμαλοῦ φῶτος, literally: 'rays of even light', v.6), it challenges and defeats the rubies of India (vv. 5–6). The discussions of light within the poem must be related – appearing respectively at the first halves of verses 5 and 6 in parallel – and they seem to reflect the differences, which are so marked in carved gems between the appearance of particular kinds of jewels or glasses under transmitted and reflected light. My interpretation here, which has been informed by the Lycurgus cup, is not the same as that by the first commentators or translators who have been stumped by the difficulties of the Greek and have therefore not attempted to interpret the poem in the light of hands-on observations about the material qualities of gems. The poem appears to be directly addressing the phenomenon exemplified by our cup. In the Lycurgus cup, the chemical composition of the glass is such that it appears green – the colour of white wine or green grapes – in reflected light (Posidippus' αὐγαῖς ἐξ ὁμαλοῦ φῶτος, v.6) and red – the colour of red wine or red grapes – in transmitted light (Posidippus' φέγγος ἔνερθεν ἄγων, v.5: i.e. light from a single directed source, in this case below). The dual appearances of the gem – as an example of spectacular engraving[31] and as a jewel whose lustre can defeat the jewels of India – are united in the incremental imagery of war, so that Darius in his engraved chariot may be said to go out to war to defeat the Indians.

Elsewhere Posidippus seems strikingly sensitive to gems that alter in changing contexts, such as the Lycurgus cup. Take for example poem 13: when the gem is anointed (with water or saliva, as one might wet a seal before impressing it in wax or clay, or with oil?) something (correctly?) restored as φέγγος (light) spreads over, or more literally 'runs all about', even 'rotates' (περιθεῖ, v.2 – echoing διαθεῖ from poem 8, v. 8). When the surface is dry, an engraved lion flashes as it reaches towards the beautiful sun. Again we have a natural wonder in a gem that offers two sorts of effect depending on whether it is wet or dry.[32] The effects are partly to do with the kinds of sparkle given off by its light under different conditions (I am not clear about what conditions precisely however) and partly a matter of when the lion appears. If the stone is a seal (as in Polycrates' seal in poem 9), then the joke may be that one wets the stone to impress the seal (and hence to see the impression of the Persian lion incised there) but in doing so one becomes more aware of the whole surface (losing sight of the image in the wetness); but when the stone is dry, one sees the lion carved in the gem much better.

This double quality of gems – and the placing of the Lycurgus cup in what we might call a general 'gemscape' of glyptic and luminous effects – is captured in a text fairly close to the cup in date, the famous ekphrasis of an amethyst ring in Heliodoros' novel, *Aethiopica*, which most scholars date to the 4th century (*Aeth.* 5.13–14).[33] Heliodoros' fictional gem is a 'sublime thing' (ὑπερφυές), as big as a maiden's eye and its stone aflame (σφενδόνην φλεγόμενον). Its golden rays do not dazzle the eye but illuminate it with its brilliance. The jewel is carved 'with a mimesis of living creatures' (εἰς μίμημα ζῳων) to show a shepherd boy and his sheep, in ways that insist on its quality as stone. The golden fleeces of the sheep (χρυσοῖς μαλλοῖς 'merely highlighted the natural blush (οἰκεῖον ἐρύθημα) of the amethyst', and the rock on which the sheep jump 'was a real rock, no imitation (οὐχὶ μίμησις), for the artist had left one corner of the stone unworked, using reality (ἀλήθεια) to produce the effect he wanted'. Here the effects are different from our cup in that there is an emphasis on incision and the unworked nature of the raw material of the precious object in contrast with its working, but also, in parallel with the Lycurgus cup, there is a strong and repeated focus on light effects, 'the sunshine of the amethyst's brilliance (ἡλίῳ τῇ φλογὶ τῆς ἀμεθύσου)', as Heliodoros puts it (5.14).

All of the above strongly suggests that the variable effects of precious gems under different kinds of light or in different conditions of use had long been the fascination of royal courts and ekphrastic texts in antiquity, with at least some clear sympotic implications, from Hellenistic times to the heyday of the romance in the 3rd and 4th centuries. In Achilles Tatius' novel there is little doubt that a precious cup with dichroic properties (although these might just be the fact that red wine will cause a translucent vessel to go red) was an item of desire and esteem both within the fictional world of the novel and for its readership. As David Whitehouse has pointed out, the *Historia Augusta*'s life of the 3rd-century imperial pretender Saturninus quotes a letter purportedly written by Hadrian to his brother-in-law, the Consul Servianus, which mentions 'parti-coloured cups that change colour, presented to me by the priest of a temple. They are specially dedicated to you and to my sister. I should like you to use them at banquets on feast days' (*Historia Augusta*, *Firmus, Saturninus, Proculus and Bonosus* 8.10).[34] Again this text – probably from the 4th century rather than the 2nd – signals the combination of the rare and remarkable properties of the objects and a sympotic context at an elite

Plate 20 The Portland vase. Roman, 1st century BC. British Museum, London (GR 1945,0927.1)

level. The *Historia Augusta* makes no mention of the material of the vessel, but both Achilles Tatius and Posidippus – especially if the gem in poem 3 is a cup – seem to be describing items of precious or semi-precious stone, like the Rubens Vase in Baltimore. Again, my point about the scientists' doubts surrounding the Lycurgus cup before it could be analyzed in the laboratory, is that it may have looked like, seemed and been taken to be a precious object of rare stone in its ancient usage.

Posidippus' poem 8, in particular, provides a vivid account of the observable and remarkable qualities of lighting found in the Lycurgus cup. It may be that these very qualities constitute its gemness – the sense of radiance and ability to change that is so remarked upon in ancient accounts of gems. It has been argued that glass is a cheap medium by contrast with precious stones like rock crystal.[35] But Achilles Tatius' term for 'rock crystal' (ὑάλου… ὀρωρυγμένης, 'glass dug up out of the ground') might suggest more ambivalence about so strong a distinction in antiquity.[36] Indeed if Achilles knew at all how glass were made, then he could very precisely be describing the process of glassmaking with 'what is dug up out of the ground' referring to the collection of sand, the basic constituent of glass.[37] One might argue that it is the panache of the object – the result of an alchemical process in ancient glassmaking whose effects are little short of magical – that comes to constitute its preciousness in an age before scientific proof. In this sense, the Lycurgus cup emulates the achievements of earlier cameo type glasses, such as the 1st century BC Portland vase (**Pl. 20**) or the extraordinary vase recently exhibited at Bonhams (if it is genuine) – in taking to the large and spectacular scale some of the most special and precious attributes of gems.[38] Its effects demonstrate a profound longevity in Roman antiquity's use of glass to reflect upon and imitate the most prized effects of gemstone carving.

Notes

1 For the class of material, see D. Harden and J. Toynbee, 'The Rothschild Lycurgus cup', *Archaeologia* 97 (1959), 179–212, especially the appendix at 203–11, whose lists are used e.g. by A. von Saldern, *Antikes Glas*, Munich, 2003, 289–99 in his discussion of diatreta. But see now H. Meredith-Goymour, 'Texts as contexts for viewing: ekphrasis, inscribed decoration and glass open-work vessels in Late Antiquity', Oxford DPhil thesis, 2006, vol. 2.

2 See D. Harden in D. Harden, *Glass of the Caesars*, London, 1987, 245–9, esp. 247; D. Harden, 'The Rothschild Lycurgus cup: addenda and corrigenda', *Journal of Glass Studies* 5 (1963), 9–17; R. G. Chirnside and P. Proffitt, 'The Rothschild Lycurgus cup: an analytical investigation', *Journal of Glass Studies* 5 (1963), 18–23; R. Brill, 'The chemistry of the Lycurgus cup', in *Proceedings of the 7th International Congress on Glass. Comptes Rendus* 2, Brussels, 1965, paper 223, 1–13. On the glass industry and production in a Roman cultural context, see E.M. Stern, 'Roman glassblowing in a cultural context', *American Journal of Archaeology* 103 (1999), 441–84, and Meredith-Goymour (n. 1), 102–8.

3 See D. Chirnside, 'The Rothschild Lycurgus cup: an analytical investigation', in *Proceedings of the 7th International Congress on Glass. Comptes Rendus* 2, Brussels, 1965, paper 222, 1–6 (on manganese); Brill (n. 2); D. Barber and I.C. Freestone, 'An investigation of the origin of the colour of the Lycurgus cup by analytical electron microscopy', *Archaeometry* 32 (1990), 33–45; I.C. Freestone, N. Meeks, M. Sax and C. Higgitt, 'The Lycurgus cup – a Roman nanotechnology', *Gold Bulletin* 40 (2007), 270–7, esp. 272.

4 See especially now R. Lierke, 'On the manufacture of diatreta and cage cups from the Pharos Beaker to the Lycurgus Cup', in this volume. On the techniques of cutting, see G. Scott, 'A study of the Lycurgus cup', *Journal of Glass Studies* 37 (1995), 51–64 and Freestone *et al.* (n. 3), 273–4; for some aspects of casting the blank (probably a double-walled rather than a thick-walled blank), see R. Lierke, 'One more time – the making of the diatreta cups', *Glastechnische Berichte. Glass Science and Technology* 68 (1995), 195–204; R. Lierke, *Antike Glastöpferei: Ein vergessenes Kapitel der Glasgeschichte*, Mainz, 1999, 104–29; R. Lierke, *Die nicht-geblasenen antiken Glasgefässe*, Offenbach am Mainz, 2009, 79–86, and E.M. Stern, 'A new window on ancient glass technology, including cameo glass and cage cups', *Journal of Roman Archaeology* 24 (2011), 619–26, esp. 624–5.

5 On the iconography of the theme, see A. Farnoux, 'Lykourgos I', *Lexicon Iconographicum Mythologiae Classicae* (hereafter *LIMC*) VI.1 (1992), 309–19.

6 The myth is retold by Nonnos, *Dionysiaca* 20.149–21.169, with the specific subject depicted on the cup at 21.17–89. On Nonnos, see L. Miguelez Cavero, *Poems in Context: Greek Poetry in the Egyptian Thebaid 200–600 AD*, Berlin, 2008, 15–25, with bibliography. On Nonnos' treatment of Lycurgus, see P. Chuvin, *Mythologie et géographie dionysiaques*, Clermont Ferrand, 1991, 254–71; N. Hopkinson, 'Nonnus and Homer', in N. Hopkinson (ed.), *Studies in the Dionysiaca of Nonnus* (Proceedings of the Cambridge Philological Society, Suppl. 17), Cambridge, 1994, 9–42, esp. 25–6.

7 Iconography: Harden and Toynbee (n. 1), 193–7; Harden 1987 (n. 2), 249; E. Simon, 'Lykourgos: Frevler, Tor, Bekehrter', *Archaiognosia*, suppl. 8, Athens, 2009, 111–24, esp. 120–2.

8 D. Whitehouse, 'Roman dichroic glass: two contemporary descriptions?', *Journal of Glass Studies* 31 (1989), 119–21, esp. 121.

9 See for instance G. Bowersock, *Hellenism in Late Antiquity*, Cambridge, 1990, 41–53 and G. Bowersock, 'Dionysus as an epic hero', in Hopkinson (n. 6), 157–66, esp. 162–4.

10 Gregory of Nyssa, *On the Divinity of the Son and the Holy Spirit*, PG 46.557: 'Throughout the city everything is taken up by such discussions: the alleyways, the market places, the broad avenues, and the city streets; the hawkers of clothing, the money-changers, the food vendors. If you ask about small change, someone will philosophize to you about the Begotten and the Unbegotten, if you ask the price of bread, the reply comes, "the Father is greater and the Son is a dependent". If you inquire whether the bath is ready, someone will respond, "the Son was created from not being".'

11 See V. Rondot, 'Le dieu à la bipenne, c'est Lycurgue', *Revue d'Egyptologie* 52 (2001), 219–49, esp. 228 for discussion of the Lycurgus cup.
12 See e.g. C. Steckner, 'Diatreta also Lichtgefaße', in Lierke 1999 (n. 4), 110–29, and Stern (n. 2), 479–80 for the rise in popularity of glass lamps in the second half of the 4th century, which is when the Lycurgus lamp is believed to have been made.
13 See Harden 1987 (n. 2), 247 with bibliography.
14 See Harden 1963 (n. 2), 10–12.
15 Contra Lierke, this volume, following Erika Simon.
16 See L. Schneider, *Die Domäne als Weltbild: Wirkungsstrukturen der spätantiken Bildersprache*, Wiesbaden, 1983, 5–38 and J. Elsner, *Roman Eyes: Visuality and Subjectivity in Art and Text*, Princeton, 2007, 200–24.
17 For Sevso's hunting plate see M. Mango and A. Bennett, *The Sevso Treasure Part 1*, Ann Arbor, 1994, 55–97, esp. 86–7 on the hunters' picnic; *cf.* the Cesena plate with similar imagery, in P. Arias, 'Il piatto argenteo di Cesena', *Bollettino d'Arte* 35 (1950), 9–17.
18 S. Ćurčic and Y. Hadjitryphonos (eds.), *Architecture as Icon*, New Haven, 2010, 158–9 with bibliography.
19 On the plain silver linings of 1st-century repoussé Roman silver cups, see D.E. Strong, *Greek and Roman Gold and Silver Plate*, London, 1966, 125, and for solid cast examples (not requiring a lining but with smooth interiors) see, ibid., 163–5.
20 In addition to items in note 3, see also U. Leonhardt, 'Optical materials: invisibility cup', *Nature Photonics* 1 (2007), 207–8.
21 Harden and Toynbee (n. 1), 180–1, 188; M. Vickers, 'Rock crystal: the key to cut glass and diatreta in Persia and Rome', *Journal of Roman Archaeology* 9 (1996), 48–65, 63 for 'jade or opal'.
22 See the discussion of Whitehouse (n. 8), 120–1, although Whitehouse is too keen to make this description dichromatic in the same sense that the Lycurgus cup is. The material is taken to be 'rock crystal' in the translation by Tim Whitmarsh, 'crystal' in the translation by John Winkler and 'rock crystal' in the Loeb edition by S. Gaselee.
23 See G. Bastianini and C. Gallazzi (eds), *Posidippo di Pella. Epigrammi*, Milan, 2001.
24 See C. Austin and G. Bastianini (eds), *Posidippi Pellaei Quae Supersunt Omnia*, Milan, 2002 (a trilingual Greek, Italian and English edition), and F. Nisetich, 'The poems of Posidippus', in C. Gutzwiller (ed.), *The New Posidippus: A Hellenistic Poetry Book*, Oxford, 2005, 17–64.
25 On the structure of the *Lithika*, see R. Hunter, 'Notes on the *Lithika* of Posidippus', in B. Acosta-Hughes, E. Kosmetatou and M. Baumbach, *Labored in Papyrus Leaves: Perspectives on an Epigram Collection Attributed to Posidippus (P. Mil. Vogl. VIII 309)*, Washington DC, 2004, 94–104.
26 E.g., P. Bing, 'The politics and poetics of geography in the Milan Posidippus section one: on stones (AB 1–20)', in Gutzwiller (n. 24), 119–40, esp. 119–20.
27 See e.g., A. Kuttner, 'Cabinet fit for a queen: The λιθικά as Posidippus' gem museum', in Gutzwiller (n. 24), 141–63, and M. Fantuzzi, 'Posidippus at court', in Gutzwiller (n. 24), 249–68.
28 Bing (n. 26), 135–9; Kuttner (n. 27), 146–9.
29 This is the meaning as rendered by both Austin and Bastianini (n. 24), 25, and Nisetich (n. 24), 17.
30 See Kuttner (n. 27), 147–9.
31 Not a cameo: *pace* E. Kosmetatou, 'Poseidippos, *Epigr.* 8 AB and early Ptolemaic cameos', *Zeitschrift für Papyrologie und Epigraphik* 142 (2003), 35–42.
32 *Cf.* M. Smith, 'Elusive stones: reading Posidippus' *Lithika* through technical writing on stones', in Acosta-Hughes *et al.* (n. 25), 105–17, esp. 111.
33 See S. Bartsch, *Decoding the Ancient Novel*, Princeton, 1989, 149; S. Dubel, 'La description d'objets d'art dans les Ethiopiques', *Pallas* 36 (1990), 101–15; E. Bowie, 'Names and a gem', in D. Innes, H. Hine and C. Pelling (eds), *Ethics and Rhetoric*, Oxford, 1995, 269–86, esp. 278–80; Vickers (n. 21), 63; T. Whitmarsh, 'Written on the body: ekphrasis, perception and deception in Heliodorus' *Aethiopica*', *Ramus* 31 (2002), 111–25, esp. 112–14.
34 Whitehouse (n. 8), 119–20; Meredith-Goymour (n. 1), 99–100.
35 Vickers (n. 21).
36 On ὑάλος as meaning both glass and crystal, see Liddell-Scott Jones and also Vickers (n. 21), 53.
37 A fact well known in antiquity: see Strabo 16.2.25 and Pliny, *Nat. Hist.* 36.200.
38 On the Portland Vase, see e.g. Harden (n. 2), 59–65, with other cameo glasses esp. 66–83. On the vase at Bonhams in October 2009, see e.g. http://www.bonhams.com/cgi–bin/public.sh/pubweb/publicSite.r?Screen=HeadlineDetails&iHeadlineNo=4405.

Chapter 13
Making Late Antique Gold Glass

Daniel Thomas Howells†

Introduction

In most of the literature published about glass bowls dating to the late 4th century and decorated on the base with Christian, Jewish, pagan and secular gold leaf images, it has been argued that these objects were the possessions of extremely wealthy individuals. Predominantly recovered from the sealing plaster of individual loculi in the catacombs of Rome and commonly known in English as 'gold glasses', the vessels were interpreted in the exhibition catalogue *Glass of the Caesars* as having been trinkets owned by those 'who already may have been so rich that they had everything'.[1] As recently as 2004, Lucy Grig has further stated that a number of the pieces were privately commissioned by the wealthy Pope Damasus of Rome (AD 366–84) or one of his inner circle to promote their aristocratic association.[2] Only Alan Cameron has suggested, albeit in passing, that gold glasses may not have been the preserve of 4th-century aristocrats.[3] This latter interpretation has not, however, been widely accepted in the subsequent literature. Based on a detailed programme of experimental reproduction, this paper for the first time examines in detail the material value of gold glass in Late Antiquity, and concludes that gold glass was unlikely to have exclusively been a very high status medium. Gold glass vessels were instead probably available to people of lesser wealth and social standing, but nevertheless would have still likely to have constituted their most treasured possessions.

The physical nature of the objects and past attempts at reproduction

Gold glass objects most often take the form of wide shallow bowls of which in the majority of cases only the decorated base discs, between approximately 50–120mm in diameter, now remain. In 1720, Marco Antonio Boldetti illustrated a complete example which he claimed was one of several to have been found in the Roman catacombs, only to be later broken in his enthusiastic attempts to remove it from the plaster.[4] Reproduced in **Plate 1**, Boldetti's illustration of a complete vessel has been met with some scepticism in the relatively recent literature.[5] Nevertheless, a near-complete vessel approximating to Boldetti's illustration is preserved in the Vatican Museum collection, still embedded in the plaster,[6] whilst another largely intact piece exists in the Metropolitan Museum of Art, New York.[7] Wide shallow bowls also appear to be the most common gold glass vessel shape based on my own detailed examination of the British Museum's collection of these objects. Furthermore, a number of the gold glasses illustrated in the 17th-century *Museo Cartaceo* are shown to retain large portions of their vessel walls, again giving the impression of wide shallow bowls.[8] In each instance, the *Museo Cartaceo* glasses were reduced to their decorated base discs as they now appear after their publication in the 1680s, and prior to their illustration for Filippo Buonarruoti's volume in 1716.[9]

Illustrated in **Plate 2a**, the gold leaf images on the base of each vessel appear fused or 'sandwiched' between two layers of colourless greenish glass, constituting the vessel bottom and the pad base disc, a flat, circular plate of glass turned down at the edges to form a foot-ring.[10] Illustrated in **Plate 2b**, gold glass vessels consisting of three glass layers

Plate 1 Marco Antonio Boldetti's illustration of the gold glass vessel he claimed to have found in the catacombs of Rome (reproduced from *Osservazioni sopra i Cimiteri dei Santi Martiri ed Antichi Cristiani di Roma*, Rome, 1720)

occur much less frequently. In the three-layer examples, the gold leaf is without exception fused between the lowermost (pad base) and the middle glass layer. In no example does the gold leaf occur fused between the middle and upper (vessel bottom) layers. In some, but not all examples, details of the gold leaf image are also enhanced with over-painted white and or red enamel (**Pl. 3**).[11]

Documented attempts to reproduce Late Antique gold glass began in the late 17th century, shortly after the first discovery of the medium in the catacombs of Rome. Crucial to the Late Antique method of gold glass manufacture was the actual fusing of the gold leaf between the two layers of glass. This has proved the most difficult aspect of manufacture to recreate in past attempts, and in many reproductions a cover layer of glass has simply been glued into place above an image produced on the base of a pre-prepared vessel.[12] Alternatively, in instances where the glass layers have been properly fused, they take the form of flat plates assembled whilst cold and the whole then heated to softening point to form panels, rather than manipulated vessel forms akin to the originals.[13] If a gold glass vessel, both with pad base disc and a shallow bowl upper layer of glass, was assembled cold and heated together causing the two layers to fuse according to this method, the heat would have caused the shaped glass to sag and become greatly distorted.

Highly successful reproductions of Late Antique gold glass vessels with gold leaf iconography fused between the

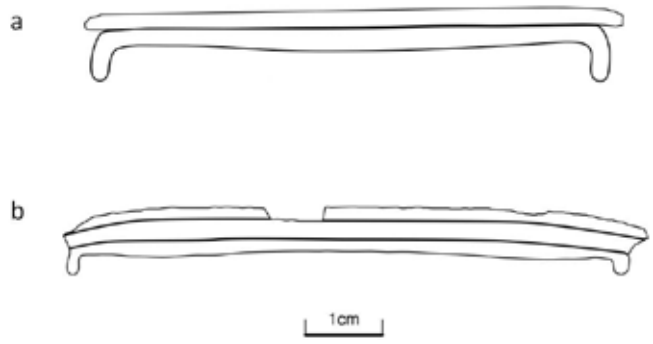


Plate 2 Late Antique gold glass vessel base profiles from examples in the British Museum, consisting of (a) two layers (PE 1863,0727.12) and (b) three layers (PE 1859,0618.1) of greenish colourless glass

pad base disc and vessel bottom were not achieved until the late 19th century.[14] The exact method employed was unfortunately never published. Alessandro Castellani (artistic adviser to the Venice and Murano Company), however, stated both in his personal papers[15] and to journalists[16] that the inspiration behind the rediscovery of Late Antique gold glass manufacture was the study of the 12th-century treatise of Theophilus.

Theophilus does not, however, provide a technique for the sandwiching of gold leaf between two layers of glass. He instead describes the application of gold leaf to the walls of glass vessels using a minimal amount of powdered glass.[17] In contrast, the 10th-century treatise of the Italian monk Eraclius does describe the fusing of gold leaf between two layers of glass with specific reference to the Late Antique gold glass of 'the Romans'. Extracts from Eraclius' work are frequently found bound together in other volumes ascribed to different authors. Indeed, the passage concerning gold glass is bound together and attributed to Theophilus in the manuscript held in the British Library.[18] It is thus quite possible that the Venetian glassworkers had also studied Eraclius' specific account, perhaps unknowingly, as well as gaining information from Theophilus himself.

Plate 3 Gold glass vessel base with husband and wife and the figure of Hercules, Rome, late 4th century. British Museum (PE 1863,0727.3)

a

b

Plate 4 The gathering and initial shaping of the glass parison for the base disc

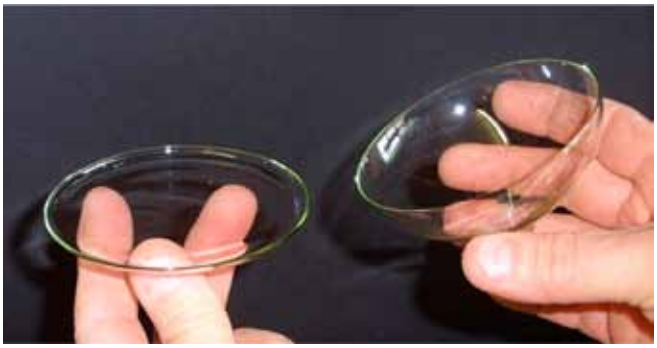


Plate 6 The parison after the cracking off process. The disc to the left is retained forming the pad base disc, whilst the majority of the parison, seen to the right, is recycled

a

b

Plate 5 Shaping the base disc parison

In his treatise *De Coloribus et Artibus Romanorum* (On the Colours and Arts of the Romans), part five, *De fialis auro decoratis* (Of Phials Decorated with Gold), Eraclius states that:

> The Romans made themselves phials of glass, artfully varied with gold, very precious, to which I gave great pains and attention, and had my mind's eye fixed upon them day and night, that I might attain the art by which the phials shone so bright; I at length discovered what I will now explain to you my dearest friend. I found gold-leaf carefully enclosed between the double glass. When I had often knowingly looked at it, being more and more troubled about it, I obtained some phials shining with clear glass, which I anointed with the fatness of gum with a paint brush. Having done this, I began to lay leaf-gold upon them, and when they were dry I engraved birds and men and lions upon them, as I thought proper. Having done this, I placed them over glass made thin with fire by skilful blowing. After they had felt the heat thoroughly, the thinned glass adhered properly to the phials.[19]

This brief description is extremely valuable for those wishing to reproduce Late Antique gold glass. Eraclius explicitly describes the gold leaf first being secured to the surface of the lower glass layer with gum and, when this had been done, engraving various depictions upon it, presumably then removing the excess leaf. He then specifically notes the heating of this gilded layer of glass, and then the blowing of a glass bubble over the top effectively fusing the gold leaf between the two. Eraclius' method forms the basis of my own attempt at experimental reproduction discussed below.

The programme of experimental reproduction

The experiences and ultimate failings of past attempts at gold glass reproduction (many of which are detailed by Renate Pillinger[20]) make it clear that any new and *bona fide* attempt at reproducing the technique should be undertaken in connection with professional glassworkers. The following programme of experimental reproduction was initiated with the aid and advice of Mark Taylor and David Hill, the 'Roman Glassmakers' who specialize in the reproduction of Roman glass for museums, re-enactors, television programmes and cinema. This experiment has been carried out using materials, tools and techniques faithful to our current understanding of those used in the 3rd and 4th centuries, the generally accepted date for the production of gold glass. Modern raw materials allow the very accurate replication of ancient glass recipes.[21] The detailed compositional analysis data from the British Museum gold glasses was used to provide a recipe for the glass used for these experiments, effectively reproducing the working properties of the glass used to produce the original objects.[22]

The first stage in the production of gold glass vessels is the creation of the pad base disc. In order to produce the base disc blank, transparent glass is gathered upon the end of the blowpipe (**Pl. 4a**), inflated, and a constriction is formed between the blowpipe and the bubble, known as the parison (**Pl. 4b**). After the parison is reheated, making the glass more pliable, the bottom is then flattened and its sides made cylindrical using a hand-held flat metal or wooden surface (**Pl. 5a**). This can also be achieved through centrifugal force. The parison is then removed from the blowpipe and, resembling an onion in shape, is placed in an annealing oven known as the lear to slowly cool over the course of one night (**Pl. 5b**). If the glass is allowed to cool more quickly it will become brittle and crack. Once it has cooled, a simple glass-working process known as 'cracking off' is employed to separate the flattened end from the rest of the parison. Illustrated to the left of **Plate 6**, this leaves the level pad base disc and a downturned foot-ring of a few millimetres. Only the flattened end is retained; the excess glass, the majority of the original parison illustrated to the right of **Plate 6**, is recycled.

The next step is to apply gold leaf to the upper surface of the pad base disc. Eraclius is quite explicit in his description of this process: pasting the glass surface with gum and laying an extremely thin layer of gold leaf directly over it. I repeated Eraclius' method, applying the naturally occurring vegetable glue gum arabic in a heavily diluted form to the top of the base disc with a brush. However, any water-soluble adhesive that evaporates completely under intense heat can be employed for this process, an obvious alternative being rabbit-skin glue. Evidence for the use of gum arabic and rabbit-skin glue, as well as a variety of other alternatives in

a b c

Plate 7 Incising the design into the gold leaf

the Roman world, is summarized by Richard Newman and Margaret Serpico.[23]

Once the adhesive is dry and the gold leaf has properly adhered to the glass, the desired iconographic depiction can then be cut and incised into it. This technique is described in detail by the late 14th-century artist Cennino Cennini in his treatise on the decoration of glass panels with gold leaf.[24] The tool used, as Cennini explicitly notes, must be sharp enough to penetrate the gold leaf and he suggests the use of a needle bound to a stick; however, the classic Roman stylus would have proved equally as effective. Cennini advocates that the colourless glass is placed upon a black, or at any rate dark, backing so that the gold leaf can be clearly seen in contrast. The design is sketched very lightly at first, and then with a heavier hand once the precise details have been defined, as illustrated in **Plates 7a–b**. Any accompanying inscription is incised in much the same way. The tops and bottoms of letters on Late Antique gold glasses are almost exclusively straight in appearance, indicating that these were initially laid out within parallel guidelines determining the height of each character.

In terms of the iconography, almost every image depicted upon gold glass vessel bases can be closely paralleled in other contemporaneous media. Furthermore, the same all-but-identical image and format occurs time and time again on separate gold glasses.[25] The classic example is the generic adult couple,[26] transformed into a family group by the addition of one or more generic children.[27] As a result, it seems probable that the images and additional composite elements could in the vast majority of cases have been transcribed from pattern books.

At this point, any over-painted enamelled details (most often red and white) can be added (as, for example, on the British Museum piece PE 1863,0727.3; **Pl. 3**).[28] The precise method is again described by Eraclius, who states that: 'If anyone wishes to paint vases with glass... let him choose for himself two stones of red marble, between which let him grind the [coloured] Roman glass, and when it is pulverized as fine as the dust of the earth, let him make it liquid with the clear fatness of gum' (*De Coloribus et Artibus Romanorum* I.3).[29] This can then be applied to the desired areas with a brush.

Once the design has been incised upon the gilded base disc (**Pl. 7c**) the excess gold leaf can be scraped away, retained and recycled. Whilst this removes the vast majority of the excess gold leaf, a light dusting of very stubborn flecks still remain upon the surface of the glass. But as the adhesive is water-soluble, these more obstinate gold leaf flecks can be easily removed with a small pointed piece of wood dipped in water. However, neither the removal of the excess gold leaf nor even the incision of the basic iconographic designs upon significant numbers of Late Antique gold glasses are carried out with great care and attention. Multiple examples show the signs of what can only be described as rather shoddy workmanship.

An example in the British Museum (**Pl 8**, 1–5) showing Daniel slaying the dragon of Babylon, encouraged by Christ as Logos to the left, incorporates many such 'mistakes'. Large amounts of excess gold leaf remain present between Christ's back (**1**) and the border as well as between Christ's hands and Daniel's back (**2–3**). In addition, Christ's feet have not been incised properly (**4–5**) and one might even go so far as to suggest that the portion of Daniel's cloak which should be visible between and to the right of his legs has been mistakenly removed. More common upon other gold glasses are very small details of the iconography and inscription, such as the crossbar of the letter A, which have been removed accidently.

When the excess gold leaf has finally been removed to the satisfaction of the craftsman, the decorated pad base disc is slowly reheated overnight in the lear to temperatures approximating to 550°c. This prevents a thermal shock and the subsequent shattering of the glass when a hot parison is blown directly on top of it to form the actual vessel. It also has the inadvertent effect of smoothing off the downturned foot ring of the pad base disc, which can be observed upon each of the Late Antique examples in the British Museum. If the temperature inside the lear rises to over 600°c, however, the downturned foot ring upon the base disc is in danger of distortion. Slightly distorted foot-rings are relatively common on Late Antique gold glasses in both the British Museum's and V&A's collections personally examined by me. Once fully heated, the gilded pad base disc is removed from the lear by pushing it onto a wooden paddle with a short stick, as illustrated in **Plate 9**. If significant care and attention are not taken, the stick may slip and brush across the gilded surface of the disc, causing the glass to rotate and creating a part oval or circular score in the gilding. This feature is present upon a number of Late Antique gold glasses, including that illustrated in **Plate 8a** (highlighted in blue).

The heated base disc, now ready for sandwiching as part of a bowl, is then placed upon the floor in a specially

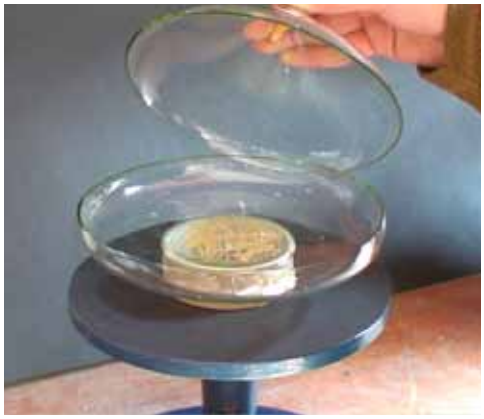
Plate 8 Gold glass (PE 1863,0727.1) highlighting in green (1–5) areas of excess gold leaf which have not been removed; in blue (a) the scored surface of the gold leaf occurring when the glass was removed from the lear

created oven-like box. This ensures that it retains its heat and thus prevents a thermal shock. Illustrated in **Plate 10**, the glassworker then stands above it and inflates a hot parison of glass of a similar temperature to the gilt disc below it, fusing the gold leaf between the two, as Eraclius implicitly describes in the passage quoted above. The fused whole can, if required, be shaped in the same manner as the base disc parison at the beginning of the process (**Pl. 5**).

Like the base disc onion bubble, the fused whole vessel is then removed from the blowpipe and slowly cooled in the lear for the night, leaving an onion-shaped bubble with the decorated base disc firmly attached to the bottom. Once cool, the cracking off process is again employed (**Pl. 11**), removing the excess upper portion of the parison (**Pl. 11a**), which can then be recycled. This leaves a vessel shaped like a shallow bowl (**Pl. 11b**). The lack of a pontil mark suggests that the vessel rim could not have been re-inserted into the furnace for

Plate 9 Removing the heated base disc from the lear onto a wooden paddle

Plate 10 Fusing the gilded base disc with the parison forming the vessel bowl



a

b

Plate 11 The vessel parison after the cracking off process. The excess upper portion of the parison is recycled (a), leaving a shallow bowl shaped vessel (b)

the application of handles or for fire polishing. As such, the vessel rim was probably smoothed using a stone whilst akin to Late Antique examples, and as noted above, the vessel foot is inadvertently smoothed by its re-heating in the lear.

If a pair of small handle loops were present on gold glass vessels as suggested in Boldetti's 1720 illustration (see **Pl. 1**), then these would have had to have been applied directly to the inflated parison prior to the process of cooling and cracking off. This would make the application of handles a relatively difficult process, and applying them in the correct positions upon the vessel wall would have been particularly tricky. Indeed, those illustrated by Boldetti cannot be paralleled in other contemporaneous glass and thus may in fact be an invention of the artist.

It is uncertain why some cut and incised technique vessel bases, seemingly identical to two-layer sandwich-glass vessel bases in technique and, in a number of instances, in iconography as well, should consist of three layers of glass. As has been noted above, the gold leaf upon three-layer glasses exclusively appears fused between the lowermost base disc layer, and the middle layer of glass. This observation is crucial. It is quite probable that upon fusing the iconography between the base disc and the vessel-bowl layer of glass, the glassworker was not happy with the shape of the bowl created by the upper parison. In response to this, and not wishing to discard the decorated base disc, the glassworker then removed what was initially intended to form the vessel walls and reheated the now two-layer base disc again in the lear. This process has the effect of smoothing out the jagged edge caused by the removal of the originally intended vessel bowl. The glassworker could then have blown a second parison over the top, forming the new and this time satisfactory vessel bowl and thus resulting in three glass layers.

In his discussion of Diocletian's Edict of Maximum Prices, Dan Barag notes that glass vessels were priced according to weight rather than form.[30] The addition of the third layer of glass would certainly have made the finished vessel a heavier object than a two-layer example; however, the small number of gold glass vessels consisting of three layers makes it unlikely that increasing the weight of the vessel in this way was intended to increase the overall value of the object. Indeed, there is little evidence that the edict was widely adopted, and is furthermore thought not to have been applied in Rome and the western empire where the majority of gold glasses have been recovered.

Although it cannot be directly evidenced once the base disc had been reheated, the removal of the unsatisfactory vessel walls for the blowing of a new parison is likely to have been carried out through the highly accurate process known as grozing. Grozing is achieved by firmly crushing, rather than snapping, the glass piece by piece between a pair of metal pliers as illustrated in **Plate 12**. This was certainly the method used to reduce the majority of gold glass vessels to their decorated base discs as they now appear (compare for example the grozed edges of the reproduction piece in **Plate 12** with the Late Antique example illustrated in **Plate 8**).

Gold glass as 'poor man's silver'?

The materials used in the manufacture of gold glass vessels were not expensive in Late Antiquity. Raw glass was in no way a highly priced or luxury commodity.[31] As demonstrated by the above programme of experimental reproduction, the amount of gold required for use in any one gold glass vessel is minimal, whilst any excess can easily be caught and recycled, as is also the case with the excess glass.[32] The degree of artistry involved in producing the gold leaf designs is certainly not of the highest standard, even more so when one considers that the images would have most probably been transferred from pattern books. Furthermore, imperfections often occur in the finished design, highlighted above in **Plate 8**, which can only be attributed to carelessness or poor workmanship.

Ultimately, once the process of fusing the gold leaf between the two layers of glass had been learned, it required no more skill than that of the very basic glassworker able to blow a simple bubble of glass. The production of base discs and the final fusing of the decorated pieces could thus have

Plate 12 Grozing the vessel walls away to the line of the foot ring, retaining only the image upon the base disc

been carried out easily in large quantities. In addition to this, Alan Cameron has emphasized that more than half of the gold glasses depicting secular personnages published in Morey's extensive catalogue of the Vatican collection are not customized. Many simply carry the generic legend 'PIE ZESES' (drink that you may live) or no legend at all.[33] This again suggests that many of the glasses were mass-produced rather than being tailored to specific individuals.

Nevertheless, it would be wrong to assume that gold glass vessels were mundane objects not highly valued by those that did own them. The only known secular person of genuine aristocratic standing to feature on a gold glass is Memmius Vitrasius Orfitus, prefect of Rome in every year between AD 354 and 359 except AD 357. Discussed in detail by Cameron, Orfitus appears on a single example in the British Museum's collection, accompanied, presumably, by his wife (**Pl. 3**).[34] The inscription in the border reads: 'ORFITVS ET CONSTANTIA IN NOMINE HERCVLIS', followed in the field by: 'ACERENTINO FELICES BIBATIS'. It is translated as 'Orfitus and Constantia, may you live/drink in happiness in the name of Hercules of Acerentia'.[35] 'ACERENTINO' almost certainly refers to the small Roman town of Acerentia (modern day Acerenza) situated on the border of Lucania and Apulia in southern Italy. It is not a misspelling or biform of 'Acheron' (the underworld).[36]

Cameron suggests that the unusual dedicatory inscription on the Orfitus gold glass indicates that it was commissioned not by Orfitus himself, but instead by the small town of Acerentia, possibly in honour of its patron. Indeed, the inscription marks this example out as different from all of the others in this category, deviating from the more common short formulae expressing wishes for life and good health. Indeed, Cameron has noted that the 'vulgar' orthography of the majority of inscriptions does not suggest an elite market for cut and incised technique gold glasses.[37] The piece also employs a slightly greater use of over-painted enamel than other examples. Furthermore, in contrast to the majority of other pieces known to me, the gold leaf incision has been carried out to a very high standard, and a great deal of care appears to have been taken when removing the excess leaf. This is particularly notable with regard to the small and highly intricate lettering making up the unusually long portion of the inscription in the field. If Cameron's hypothesis is correct, this would suggest that gold glass was deemed valuable enough to be presented to an aristocratic person relative to the more modest wealth of a small settlement such as Acerentia. By implication, the intended aristocratic recipient for this particular gold glass may have necessitated rather more care in the production of the object itself, and suggests that whilst gold glass may have been deemed expensive, it was not usually produced for an aristocratic market.

The price of glass in the 4th century can be further considered in the context of Diocletian's Edict of Maximum Prices. Written in AD 301 for use in the eastern provinces, the edict is a very comprehensive document and specifies the prices of 700 or 800 different products, including glass. The surviving sections relating to glass have been examined by Dorothy Charlesworth and Dan Barag.[38] In Barag's most recent discussion of the edict recovered from Aphrodisias (Asia Minor), he notes a *libra* of glass occurring in line 7a as valued at 40 *denarii*, by far the most expensive item noted in the entire document.[39] Following a brief mention by Stern,[40] he goes on to note his temptation to reconstruct the missing fragment of line 7a as 'YAOY XPYOY', translated as 'of gold glass'.[41] Rather than referring to Late Antique gold glass as discussed in this paper, however, which is generally dated to the latter part of the 4th century and rarely recorded as coming from the eastern empire, it is most likely that this line refers to gold glass for mosaic tesserae.[42]

Nevertheless, providing that this reconstruction of the complete sentence is correct, the fundamental implication of line 7a of the Aphrodisias copy of Diocletian's Edict strongly suggests that glasses incorporating gold in some unspecified form were considered to be more expensive than vessels made of glass alone. Furthermore, prices from other documentary sources dating to the AD 360s indicate that the cost of most goods were always higher in Rome (where the majority of gold glass has been found) than anywhere else.[43] That Late Antique gold glass was perhaps more expensive relative to other contemporary glassware does not mean, however, that it was only available to the very wealthy in 4th-century Rome.

The apparent wide shallow profiles of most gold glass vessels that allows the image to be clearly viewed suggests that these objects, like contemporaneous silver plate, functioned primarily for display purposes. Although produced as bowls, gold glasses are unlikely to have served as functional tableware. Indeed, the shallow bowl form is in the first instance the easiest way of producing a gold leaf image protected between two layers of glass and enables the design to be highly visible when displayed. Furthermore, in the case of almost half of the gold glasses in the British Museum's collection where the foot-ring or part of the foot-ring is preserved (8 out of 20 pieces), the profiles reveal that the concave vessel base is lower (in some instances considerably) than the height of the foot-ring (PE 1854,0722.3, 1863,0727.3-4,7-8,11, S.121 and 1886,1117.330). This means that the bowl could not have been stable when placed on a flat surface and, ultimately, was unlikely to have been a functional object. Nevertheless, shallow bowls were a popular glass form as well as other media such as ceramics in the later 4th century. As such, this form may well have contributed to making gold glass vessels more saleable, even if the shallow bowl profile did not relate to any specific function.

If gold glass was used for display purposes in the same way as contemporary silver plate, then it is important to contrast the monetary value of both 'gold glass' and silver in Diocletian's Edict. The surviving sections of the edict concerning silver are unfortunately too fragmentary to be of use;[44] nevertheless, the data for 'common metals' such as copper, bronze and brass do survive. In each instance they are valued considerably higher, indeed more than double per pound than the entry for 'gold glass'. The price of silver in the edict is thus likely to have been higher still. Indeed, the place of glass in relation to silver in the 'hierarchy of materials' is well illustrated in a late 3rd to 4th century text from Roman Galilee discussing the criteria for public assistance.[45] It states that 'if a man formerly used gold vessels,

he must sell them and use silver vessels; if he used silver vessels, he must sell them and use bronze vessels; if he formerly used bronze vessels, he must sell them and use glass vessels' (Tosephta *Peah* 4:11).[46]

Complementary to the above discussion, based on Diocletian's Edict, one might thus conclude that gold glass was certainly an expensive medium in 4th-century Rome, particularly in relation to other glassware. It was not, however, the preserve of those who could afford silver plate to fulfil the same proposed function of display. Indeed, there appears to be no obvious alternative high status glassware fulfilling this function from the city of Rome during the late 4th century. As a result, a gold glass such as the British Museum's example dedicated to the aristocrat Orfitus, may not have been too out of place in the homes of the extremely wealthy, and would certainly have constituted a suitable gift from the members of a small community to its wealthy patron.

Nevertheless, it seems highly likely that gold glass was also affordable to persons lower down the social scale, but who could not afford luxurious silver plate for display purposes. These individuals may perhaps have included the more successful amongst the traders and craftsmen identified as being interred in the same areas of the catacombs from which the majority of gold glasses has been recovered.[47] Whilst gold glass items are thus likely to have been among the most valuable objects in the homes of such individuals, the vessels are likely to have been less valued items in the homes of extremely wealthy silver-owning aristocrats such as Orfitus.

Acknowledgements

The research for this paper originally formed part of my AHRC collaborative doctoral scholarship at the University of Sussex and the British Museum. As such, I owe an enormous academic debt to my supervisors Professor Liz James (Sussex) and Chris Entwistle (British Museum) both for their advice and guidance given during the initial study and for commenting on the draft of this paper. The experimental glass working was undertaken under the highly enthusiastic guidance of Mark Taylor and David Hill, who furthermore provided unreservedly their thoughts and advice on Roman glass working, the result of considerable specialist experience. The practical work itself was made possible through a series of generously awarded grants from the Glass Association, University of Sussex Graduate Centre and the Association for the History of Glass.

Notes

1 D.B. Harden *et al.*, *Glass of the Caesars*, Milan, 1987, 268.
2 L. Grig, 'Portraits, pontiffs and the Christianisation of fourth-century Rome', *Papers of the British School at Rome* 72 (2004), 203–29, esp. 208–12.
3 A. Cameron, 'Orfitus and Constantius: a note on Roman gold-glasses', *Journal of Roman Archaeology* 9 (1996), 295–301, esp. 299–300.
4 M. Boldetti, *Osservazioni sopra i Cimiteri dei Santi Martiri ed Antichi Cristiani di Roma*, Rome, 1720, 191–2.
5 E.g. D. Barag, 'A Jewish gold glass medallion from Rome', *Israel Exploration Journal* 20 (1970), 99–103, esp. 99; S.H. Auth, 'A fragmentary Christian gold-glass at the Newark Museum', *Journal of Glass Studies* 21 (1979), 35–8, esp. 37, n. 16.
6 Inv. no. 621 (ex-763); C.R. Morey, *The Gold-Glass Collection of the Vatican Library with Additional Catalogues of other Gold-Glass Collections*, G. Ferrari (ed.), Vatican City, 1959, 5, pl. II, no. 11.
7 Inv. no. 17.194.357; Morey (n. 6), 74, pl. XXXVI, no. 457.
8 E.g. J. Osborne and A. Claridge, *The Paper Museum of Cassiano Dal Pozzo, Series A, Antiquities and Architecture, Part Two, Early Christian and Medieval Antiquities, Volume Two, Other Mosaics, Paintings, Sarcophagi and Small Objects*, London, 1998, no. 256, 216.
9 F. Buonarroti, *Osservazioni sopra Alcuni Frammenti di Vasi Antichi di Vetro Ornati di Figure Trovati nei Cimiteri di Roma*, Florence, 1716.
10 J. Price and S. Cottam, *Romano-British Glass Vessels: A Handbook* (Council for British Archaeology), York, 1998, 29.
11 E.g. Harden *et al.* (n. 1), no. 155, 280.
12 E.g. D. Whitehouse, 'Two 19th-century forgeries of gold glasses in the Corning Museum of Glass', *Journal of Glass Studies* 36 (1994), 133–5.
13 E. Dillon, *Glass*, London, 1907, 93; R. Pillinger, *Studien zu römischen Zwischengoldgläsern* (Österreichische Akademie der Wissenschaften), Vienna, 1984, pl. 27, figs 180–1.
14 J. Rudoe, 'Reproductions of the Christian glass of the catacombs: James Jackson Jarves and the revival of the art of glass in Venice', *Metropolitan Museum Journal* 37 (2002), 305–14; J. Rudoe, 'A Venetian goblet made for the Paris Exhibition of 1878 with gold leaf medallions of Early Christian martyrs', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003, 220–5.
15 Rudoe 2002 (n. 14), 311.
16 Rudoe 2003 (n. 14), 216.
17 Theophilus, *De Diversis Artibus*, J.G. Hawthorne and C.S. Smith (trans.), Chicago, 1963, 59–60.
18 Eraclius, *De Coloribus et Artibus Romanorum* in M.P. Merrifield (trans.), *Original treatises dating from the XIIth to XVIIIth centuries on the arts of painting, in oil, miniature, mosaic, and on glass*, London, 1849, 167.
19 Merrifield (n. 18), 187–8.
20 Pillinger (n. 13), 63–78.
21 M. Taylor and D. Hill, 'The reproduction of Roman glass', in D. Whitehouse (ed.) *Reflecting Antiquity: Modern Glass Inspired by Ancient Rome*, The Corning Museum of Glass, New York, 2007, 75–81, esp. 76.
22 Andrew Meek, unpublished British Museum Science Report, Project Number 7434 (2008).
23 R. Newman and M. Serpico, 'Adhesives and binders', in P.T. Nicholson and I. Shaw (eds), *Ancient Egyptian Materials and Technology*, Cambridge, 2000, 475–94.
24 Cennino Cennini, *Il libro dell' Arte o Trattato della Pittura*, in C.J. Herringham (trans.), *The Book of the Art of Cennino Cennini: a Contemporary Practical Treatise on Quattrocento Painting Translated from the Italian, with Notes on Mediaeval Art Methods, by Christiana J. Herringham*, London, 1899, 154–6.
25 E.g. Morey (n. 6), pl. XXVI, no. 241 and pl. XXIX, no. 314.
26 E.g. ibid., pl. XXXIII, no. 397.
27 E.g. ibid., pl. XXIX, no. 315.
28 Illustrated in Harden *et al.* (n. 1), no. 155, 280.
29 In S.J. Fleming, *Roman Glass: Reflections of Cultural Change*, Philadelphia, 1999, 191.
30 D. Barag, 'Recent important epigraphic discoveries related to the history of glassmaking in the Roman period', in *Annales du 10e Congrès de l'Association Internationale pour l'Histoire du Verre*, Amsterdam, 1987, 109–16, esp. 116.
31 E.g. E.M. Stern, 'Roman glassblowing in a cultural context', *American Journal of Archaeology* 103/3 (1999), 441–84.
32 M. Sternini, *La fenice di sabbia: storia e tecnologia del vetro antico*, Bari, 1995, 44; M. Sternini, *Una manifattura vitraria di V secolo a Roma*, Florence, 1989, 59–64.
33 Cameron (n. 3), 300.
34 Cameron (n. 3); D. Buckton (ed.), *Byzantium: Treasures of Byzantine Art and Culture from British Collections*, London, 1994, 31–2, no. 9b.
35 Cameron (n. 3), 298.
36 As translated for instance, in Harden *et al.* (n. 1), 280, no. 155; Buckton (n. 34), 31–2, no. 9b.
37 Cameron (n. 3), 298.
38 D. Charlesworth in K.T. Erim and J. Reynolds, 'The Aphrodisias Copy of Diocletian's Edict on Maximum Prices', *Journal of Roman Studies* 63 (1973), 99–110, esp. 108–9; Barag (n. 30), 109–16.

39 D. Barag, 'Alexandrian and Judaean glass in the price Edict of Diocletian', *Journal of Glass Studies* 47 (2005), 184–6, esp. 184.
40 Stern (n. 31), 466.
41 Barag (n. 39), 184.
42 Stern (n. 31), 466.
43 R. Duncan-Jones, *The Economy of the Roman Empire: Quantative Studies*, Cambridge, 1982, 366–9.
44 E.J. Doyle, 'Two new fragments of the Edict of Diocletian on Maximum Prices', *Hesperia* 45.1 (1972), 77–97, esp. 95.
45 For a full discussion of the date of this text see: M. Goodman, *State and Society in Roman Galilee AD 132–212*, New Jersey, 1983, 9–10.
46 Translated in M. Vickers, 'Rock crystal: the key to cut glass and diatreta', *Journal of Roman Archaeology* 9 (1996), 48–65, esp. 49.
47 A. Ferrua, *The Unknown Catacomb: A Unique Discovery of Early Christian Art*, Florence, 1991; Cameron (n. 3), 299.

Chapter 14
Gold Glass in Late Antiquity
Scientific Analysis of the British Museum Collection

Andrew Meek

Introduction

The British Museum's collection of Late Antique gold glass is one of the largest in the world. The collection is made up of 55 gilt glass plaques, vessel bases and medallions. They consist of single layers of colourless glass, in the case of the gilt glass plaques, or multiple layers of colourless or coloured glass sandwiching a gold decoration, in the case of the vessel bases and medallions. This gold decoration is most commonly applied to, and sandwiched between, the glass in the form of cut and incised gold leaf.[1] However, in the British Museum collection there is one example of a gold powder, 'brushed', decorated item (**Pl. 1**) in addition to one gold trail decorated item (**Pl. 2**). The latter object is particularly rare as fewer than 20 gold trail decorated items are known to exist.[2]

The decoration on the gold glass objects can include Christian, Jewish, pagan or secular iconography, and many of them came into the museum without provenance. The findspots of the majority of the items in the collection are unknown and many potential production locations have been suggested in the past.[3] These studies are based on supposed findspots and very minor stylistic differences in the decoration of the objects. These gold glass objects were produced in Late Antiquity, a period of transition between Classical antiquity and the Middle Ages, ranging approximately from the mid-3rd until the mid-7th centuries.

The varying decorative techniques employed on these objects can be used to divide them into different categories.[4] The vast majority of samples exhibit a relatively similar level of artistic skill and show many of the same characteristics (see **Pl. 3** for an example). This has led Daniel Howells to the conclusion that they may have been produced in the same workshop by a limited number of craftsmen.[5]

There is a further decorative style of cut and incised objects of which there are only a few recognizable samples in

Plate 1 'Brushed' gold glass vessel base decorated with a bearded male bust and a gilt and jewelled casket with two rampant lions on the lid, diameter 5.1cm. British Museum, London (GR 1890,0901.1)

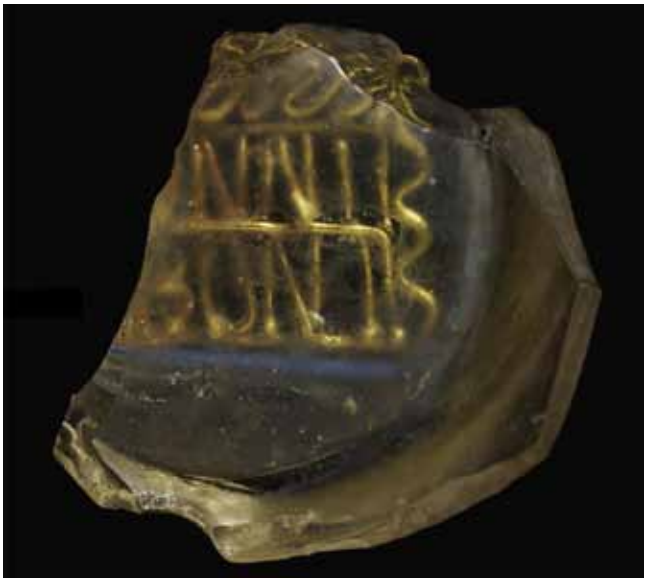


Plate 2 'Trailed' gold glass vessel base with two-line inscription '(A) NNI BONI'. British Museum, London (PE OA 858)

the British Museum's collection (**Pl. 4**). In most cases the style is not remarkably more developed than the first subgroup; however, they all exhibit 'hatched' shading, normally on the limbs of the individuals depicted on them. Charles Morey has commented that this style of decoration is reminiscent of items of the 'brushed' technique.[6] For this article objects decorated in this style are labelled as 'shaded', to differentiate them from the vast majority of objects which are 'unshaded' (**Table 1**). The majority of cut and incised objects in other large collections, for example the Vatican, Louvre and Victoria & Albert Museum, are also of the 'unshaded' style.[7]

For this project, where an object is too fragmentary to assign it to a group it has been labelled as indeterminate and placed with the 'unshaded' items. It is important to note here that all six single layer objects in this group are of indeterminate style, rather than definitely 'unshaded'. This is either due to a lack of figures featured in the design or the size of the fragments analyzed. **Table 1** summarizes the object types which have been analyzed in this study, and also those previously analyzed by Robert Brill from the Corning Museum of Glass[8] and the Cleveland Museum of Art.[9]

Previous work

The quantity of scientific data collected on first millennium glass has greatly increased over the last few decades.[11] The number of objects analyzed in this study is rather limited and therefore use will be made of the large datasets compiled in the multitude of papers that can be found on the subject.

Roman glass is characterized by its soda-lime-silica composition. It was produced using a soda-rich (Na_2O) mineral alkali source known as natron. This results in a glass with a composition that is low in magnesia (MgO) and potash (K_2O), in relation to plant and wood ash glasses. The lime (CaO) content of the glass results from the introduction of limestone or shell with the sand source used. In some cases the quantity of lime and presence of impurities characteristic to particular sand sources can be used to suggest a provenance for the glass.[12]

There are several theories on the organization of production of naturally coloured glass from raw materials in this period. Some support the idea that production was concentrated at a number of large sites in the eastern Mediterranean and others believe that glass was produced at a local level at multiple smaller sites in both the eastern and western provinces of the Roman Empire. The production of large quantities of glass in the eastern Mediterranean during the Late Roman period can be supported by excavated evidence.[13] However, the possibility of primary production occurring in the north-western provinces can be suggested through analytical data and documentary evidence.[14]

However, the organization of the production of colourless glass may provide an even more complex problem. Harriet Foster and Caroline Jackson have analyzed large numbers of both naturally coloured and colourless Roman glasses.[15] They believe that their data supports the idea of centralized production locations, potentially in both the eastern and western provinces. Furthermore, they argue that a significant quantity of the colourless glass reaching Britain in the 4th century was produced by mixing compositionally different colourless glasses.

Compositional categories

Variations in the chemical composition of colourless glasses have been divided into useful categories by a number of authors.[16] Rather than confuse the issue by inventing a new set of compositional categories, throughout this article the compositional type notation used by Foster and Jackson will be employed (**Table 2**).[17] The variations in composition can be the result of intentional or unintentional additions to the glass. Altering a raw material type can alter the composition of the glass produced, for example, exchanging beach sand for quartz pebbles, or natron for plant ash. Using a different source of the same raw material type can also alter the composition of the glass, for example, using beach sand

Table 1 Samples analyzed for this project and other gold glasses previously analyzed by Brill[10] from the Cleveland Museum of Art (CMA) and the Corning Museum of Glass (CMG) that will be discussed alongside the objects from the British Museum

Decoration	Form	No. of objects in study	Previously analyzed
Trailed	Multiple layers	1	0
Brushed	Multiple layers	1	0
Cut and incised (unshaded/indeterminate)	Single layer	6	0
	Multiple layers	22	1CMG
Cut and incised (shaded)	Single layer	2	0
	Multiple layers	1	1CMA, 1CMG

Plate 3 Cut and incised 'unshaded' gold glass vessel base depicting Christ and selected saints, diameter 9.1cm. British Museum, London (PE 1863,0727.9)

Plate 4 Cut and incised 'shaded' gold glass vessel base depicting a gladiator, diameter 8.9cm. British Museum, London (PE 1898,0719.2)

sources high or low in iron-rich impurities. Finally, the addition of extra raw materials, such as decolourants or colourants, and associated impurities, will introduce further components to the glass.

Clearly in the case of colourless glasses, the simplest division can be made between the use of different decolourants. These decolourants are added to the glass batch to counteract the blue/green colour caused by iron impurities in the silica source used. Those commonly used in Roman glass production were manganese and antimony. Antimony is not found as an impurity in sand or natron above the level of a few parts per million.[19] Therefore if levels of antimony over this amount are found in glasses they are the result of an intentional addition as a decolouring agent. This is not the case for manganese. Manganese is present in some soils and sands known to have been used to produce Roman glass, and so if low levels (<0.2 %) are found, they may be due to these impurities.[20] Some colourless glasses contain both antimony and manganese. Foster and Jackson suggest that these colourless glasses are the result of recycling or mixing of glasses.[21] The discovery of this glass composition may be linked to difficulties in obtaining a consistent source of colourless raw glass.

The types defined by differences in decolourant can be further divided based on components associated with the basic raw materials. Due to the compositionally consistent alkali raw material used in the production of these glasses, it is variations in the sand sources used that are responsible for the changes in composition that are observed. Calcium oxide, iron oxide and aluminium oxide enter the glass composition with the sand source in the form of shell or limestone, iron-rich minerals and aluminium-rich minerals, such as feldspars, respectively. Variation in the levels of these oxides can be used to signify an alteration in the sand sources exploited by the glassmakers. These markers have been used by various authors to suggest compositions that may be linked to the locations of different Roman glass production sites.[22]

Table 2 Compositional categories of colourless Roman glass[18]

Type		Description
1		Antimony decoloured
2	a	Manganese decoloured (low calcium)
	b	Manganese decoloured (high calcium)
3		Antimony and manganese decoloured

Methodology

Samples

The vast majority of the Museum's collection of vessel bases and gilt-glass plaques have been analyzed using either scanning electron microscopy-energy dispersive X-ray spectrometry (SEM-EDX) or surface micro X-ray fluorescence (XRF). Fifteen have been analyzed by SEM-EDX and 20 by XRF, the overall total number of objects being 33 as two objects were analyzed using both techniques. These two techniques were chosen as they are micro- and non-destructive, respectively. The information they can provide differs, but is complimentary. The methodology employed for the use of each technique is discussed below.

SEM-EDX

To obtain a quantitative chemical analysis of some of the glass samples a fragment was mounted in a 2.5cm diameter epoxy resin block, polished to a 1μm diamond paste finish, coated with carbon and analyzed using SEM-EDX. All of the objects have heavily fractured edges and therefore micro-destructive sampling was possible with the minimum impact on the object.

The samples were examined and analyzed in a Hitachi S3700 SEM with attached Oxford Instruments INCA EDX analyser using the following operating conditions: high vacuum mode, 20 kV electron beam, 0-10 keV spectral range, 2.30 nA probe current and a 150 seconds live time. Quantitative analysis was carried out using a calibration

produced using metal, mineral and oxide standards. The Corning A and B glass standards were analyzed to assess that this calibration was producing the correct results. These operating conditions give accuracy levels of better than 20 percent relative for all oxides and elements measured. Detection limits were calculated using a spectrum synthesis programme on Oxford Instruments INCA Analyser software. This methodology resulted in detection limits for most metal oxides of around 0.1 weight percent (wt%) or lower. However, the detection limits for some oxides were considerably higher: 0.18 wt% for PbO and Na_2O, and 0.24wt% for Sb_2O_3.

Apart from one of these samples (PE 1863,0727.7) the results presented are only for one glass layer of each object. In the one case where both layers were analyzed by SEM-EDX, they were found to have essentially the same chemical composition and the data for this object is presented as an average of these two layers. All XRF analyses were carried out on all layers of each object and intra-object compositional differences were found to be negligible. Therefore it is believed that the single layer analysis is acceptable as a representation of the composition of each layer of the multilayer objects.

Surface-XRF

Surface XRF was used as a time efficient means of obtaining large quantities of data entirely non-destructively. The unprepared objects were analyzed using a Bruker ARTAX spectrometer using the following operating conditions: helium atmosphere, 50 kV, 0.5 mA current, 0.65mm diameter collimator and 200 seconds counting time.

The surface analysis of glass objects can provide results which are not consistent with the bulk composition. This is due to a process of weathering which occurs over time. It results in the leaching out of alkali components from the surface and an associated enrichment of silica. However, the glasses analyzed for this study were relatively free from weathering. In the few cases where parts of the surface of objects were visibly deteriorated, a non-deteriorated area was chosen for analysis.

Using this methodology the XRF analysis was able to provide semi-quantitative results, i.e. to identify the presence/absence of elements and relative proportions. Elements of lower atomic number than silicon could not be quantifiably detected under the conditions used. A methodology similar to that used by Justine Bayley was employed to provide a means of comparing the spectra obtained by XRF.[23] Bayley divided the peak heights for a selection of significant elements with those found for silicon.[24] In the present study, rather than peak heights, peak areas are used. This provides a larger number of counts, thereby reducing the potential errors produced. To produce comparable results this method relies on a relatively consistent level of silicon being present in the objects. The percentage of silica (SiO_2) in those glass samples analyzed by SEM-EDX was consistently between 67 and 71 wt%. Assuming that all the glasses analyzed by XRF will have similar silica levels, these differences will only have a small effect on the ratios determined by surface XRF.

Unlike SEM-EDX analysis, only a small number of elements of particular interest were selected for study. These were: iron, manganese, antimony, calcium and lead. The peak areas measured were the K_α peaks apart from lead where the L_α peak was used. The numbers quoted in the appendix and throughout the text are ratios of the two peak areas without any conversion factor. They should not be considered quantitative or directly relatable to percentage compositions.

Results (SEM-EDX)

Introduction

As expected from previous studies, all the samples analyzed are low magnesia, low potash, soda-lime-silica glasses produced with a mineral sodium source. This is consistent with Roman glass of this period. The colourless glass used to produce gold glass objects can be divided into two main compositional types based on the results of the SEM-EDX analysis: Type 1 is antimony-decoloured; Type 2 is manganese-decoloured (**Fig. 1**). There are no objects which contain neither antimony nor manganese. Type 2 glasses

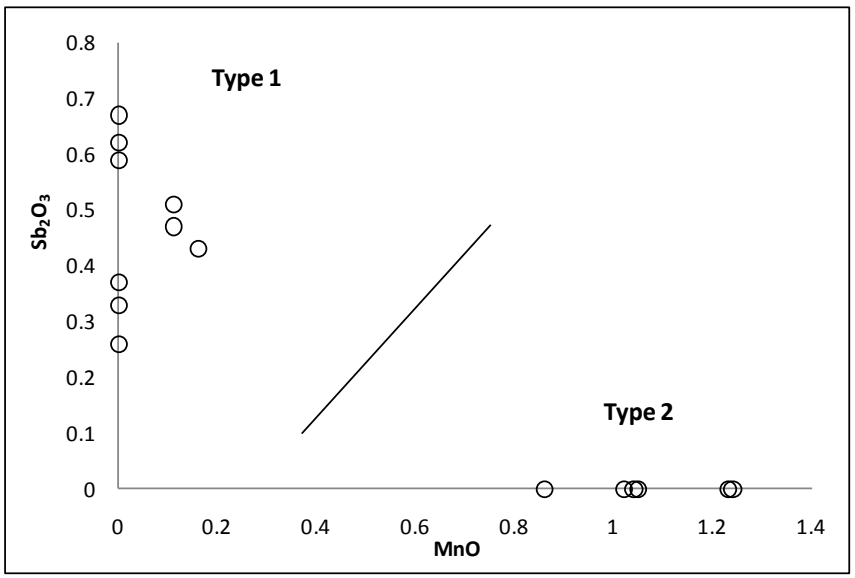


Figure 1 SEM-EDX results for antimony oxide versus manganese oxide in wt%

Table 3 Average values for the three glass (sub)types found by SEM-EDX analysis (wt.%)

Type	*n.*	Na_2O	MgO	Al_2O_3	SiO_2	Cl	K_2O	TiO_2	CaO	MnO	FeO	Sb_2O_3
1	9	19.47	0.47	1.72	69.48	1.42	0.44	0.10	5.90	0.04	0.33	0.47
2a	3	18.81	0.73	2.36	67.42	1.33	0.53	0.09	6.41	0.97	0.57	-
2b	3	15.67	0.65	3.02	70.10	1.03	0.67	0.06	8.70	1.17	0.40	-

can be divided into a further two subgroups, discussed below.

The relatively high detection limits for Sb_2O_3 must be borne in mind when discussing these data. Some of the glasses labelled as manganese decoloured, Type 2, may in fact contain a significant quantity of Sb_2O_3 (≤ 0.24 wt%) that could not be detected. Therefore it is possible that some may be composed of recycled glass, containing both decolourants (see section on compositional categories). No copper or lead was detected in any of the glasses analyzed here. The presence of these two components would suggest that recycling of glasses, including coloured glasses, had taken place.[25] However, the high detection levels for lead oxide (PbO) inherent in the SEM-EDX methodology (0.18 wt%) must again be taken into account.

Type 1

Type 1 glasses can be differentiated from other glasses by their antimony oxide levels (**Fig. 1**). These glasses also have some of the lowest iron oxide and alumina contents. This implies that they were made using a low impurity sand source, with a low lime content.[26] This may be the result of a purification process that removed impurities from the sand, or the selection of a sand source which was naturally freer from mineral and lime impurities.

All but one of the Type 1 glasses analyzed by SEM-EDX consist of a single layer of glass. This suggests that these single layer objects, rather than being the result of a splitting of a 'sandwich', may actually constitute a separate production group and have been intentionally made as single layered objects consistently from antimony decoloured glass. These single layered objects all have 'cut and incised' decoration, either of the 'shaded' or indeterminate type. There may therefore be a link between 'shaded' decoration and Type 1 composition. This will be discussed further in terms of the XRF analyses.

The only multilayered SEM-EDX-analyzed object which is of Type 1 composition is decorated with gilded rods, rather than cut and incised gold leaf (**Pl. 2**). This object is believed to date to the late 3rd or early 4th century, making it one of the earliest in the collection.[27] This discovery is consistent with the work of previous authors,[28] who suggest that antimony-decoloured Type 1 glasses were no longer produced after the 4th century.

Type 2

Type 2 glasses are characterized by the presence of around 1 wt% manganese oxide (**Fig. 1** and **Table 3**). Some contain low levels of antimony, but these are below the levels which can be quantified using the current methodology (see results in **Table 6**). All of the objects identified as Type 2 composition by SEM-EDX analysis are multilayer objects with a cut and incised decoration of either 'unshaded' or indeterminate type.

The Type 2 glasses can be divided into two further subtypes based on calcium, aluminium and iron oxides. Type 2b glasses have higher calcium oxide and alumina levels, but lower iron oxide levels than Type 2a (**Figs 2** and **3**). These three oxides are associated with impurities in the silica sources used in Roman glass production. These two glass types are therefore likely to have been produced in two separate locations, using sand sources with differing impurity contents. The current levels of both archaeological and analytical data available do not allow these locations to be identified. However, Ian Freestone has been able to use data on the calcium carbonate content of sands on the Levantine coast,[29] along with documentary evidence, to suggest that glass with a lime content of 8–9

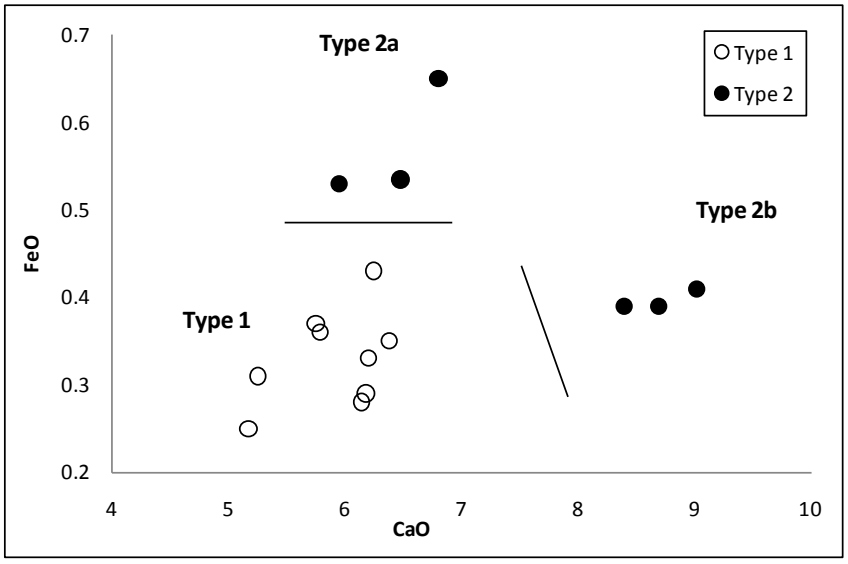


Figure 2 SEM-EDX results for FeO and CaO in wt%

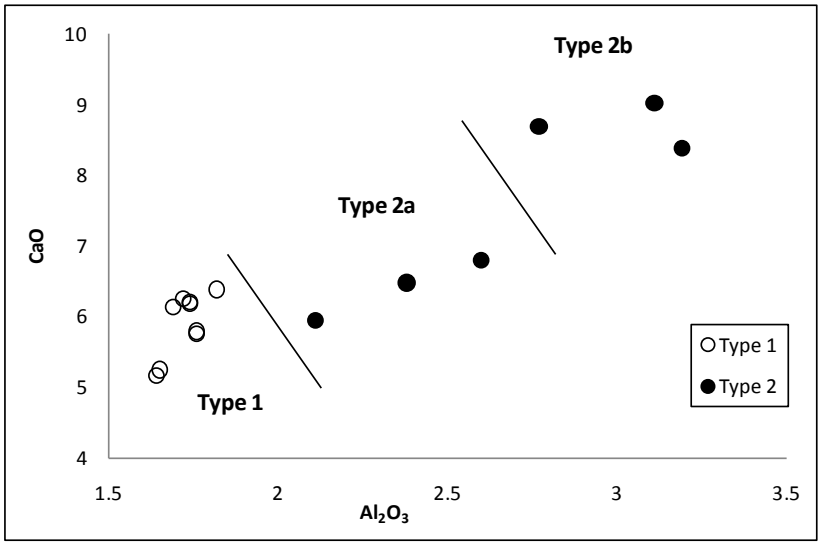


Figure 3 SEM-EDX results for CaO and Al_2O_3 in wt%

wt% could have been produced from sand found in the Bay of Haifa.

Results (XRF)

Introduction

The information obtained by XRF analysis is not of the same level of detail as that found by SEM-EDX. However, this semi-quantitative data still allowed the samples to be compared, and divided into compositional groups (**Tables 4** and **7**). The layers of glass within each object were found to be compositionally very similar. An average was therefore taken where two or three layers were analyzed. The use of the same glass on the two or three layers of each object makes good sense from a production perspective. In the case of the multilayer objects in particular, the shrinkage of the glass layers upon cooling, if different, would cause the object to fracture.

Both manganese and antimony were also found in the glasses analyzed by XRF. Using XRF it was also possible to identify a further compositional type which contains a mixture of antimony and manganese (**Fig. 4**). As stated above, the SEM-EDX results do not preclude a mixture of both decolourants in some of the samples analyzed above, due to the high detection limits for Sb_2O_3. Due to the methodology employed it is not possible to directly compare the SEM-EDX and XRF results. However, by analyzing some of the same samples using both techniques it is possible to examine whether the groupings found by each technique are consistent. Reassuringly, the analysis of objects 1859,0618.4 and 1859,0618.5 by both techniques gave results that led to the objects being placed in the same compositional group (see **Tables 5** and **6**).

Table 4 Compositional types from semi-quantitative XRF analysis

Type	*n.*	Mn/Si	Sb/Si	Ca/Si	Fe/Si	Pb/Si
1	4	0.10	0.61	1.54	1.38	0.18
2a	1	2.26	0.09	1.54	2.30	0.07
2b	10	2.46	0.02	2.12	1.33	0.03
3	5	1.77	0.35	1.65	2.47	0.15

Type 1

A total of four objects were found to be of Type 1 composition. Two of the Type 1 objects analyzed by XRF are single layered objects that were also analyzed by SEM-EDX (PE 1859,0618.4 and PE 1859,0618.5). The remaining two objects are both multilayered objects. Due to their coloured backing glass, only one colourless glass layer could be analyzed (**Pls 1** and **4**). From a design point of view these examples are distinct from the majority of multilayered objects analyzed in this project. The first is decorated with gold powder, rather than leaf or trail, and one of the two layers is made from blue glass (**Pl. 1**). This object is believed to date to the late 3rd or early 4th century.[30] This object differs from all of the other Type 1 glasses due to its elevated iron levels that are comparable with Type 2a glasses. This object may have been produced using a sand source similar to those used for Type 2a glasses, but with the addition of antimony rather than manganese (see **Fig. 5**).

The second Type 1 multilayered object (**Pl. 4**) is decorated with cut and incised gold leaf and some silver and brown decoration. This object has a distinctive opaque light blue backing glass layer and is incised in the more intricate 'shaded' style than the majority of other cut and incised objects in the British Museum collection. This discovery adds further evidence to the link between 'shaded' objects and Type 1 composition glass suggested by the SEM-EDX results.

There are two examples of glass in other museums, analyzed by Brill,[31] which can be added to the Type 1 composition group to provide a wider picture. The Alexander Plate (Cleveland Museum of Art, 1969.68) and the 'Fragment with Avitus' (Corning Museum of Glass, 54.1.83) are also cut and incised multilayered objects decorated in the 'shaded' style similar to **Plate 4**. The similarity in decoration and compositional type of these objects shows that their production was probably related and in some way distinct from the majority of cut and incised objects.[32] They may have been produced at a different location, or perhaps just by a different hand and at the same location as the other cut and incised objects. The use of antimony in their production suggests that they may predate the other cut and incised objects.[33]

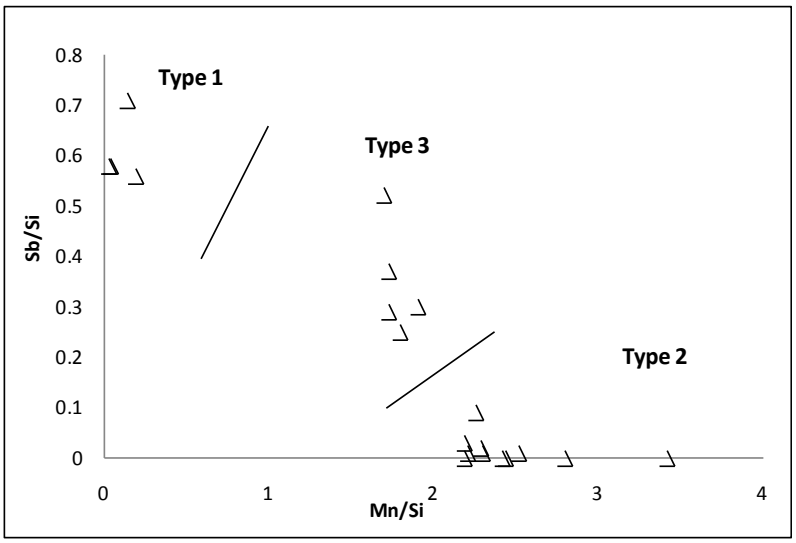


Figure 4 Semi-quantitative XRF results for Sb/Si and Mn/Si ratios for gold glasses cf. Fig. 1. Each point represents a single object and many are the average of two or more analyses of different layers

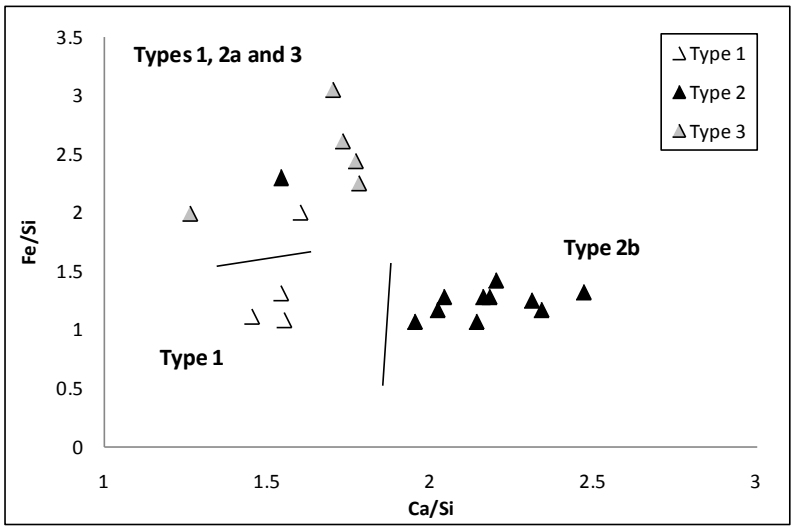


Figure 5 Semi-quantitative XRF results for Fe/Si and Ca/Si. Cf. Fig. 6

Type 2

A further 11 examples of Type 2 glasses have been found by XRF. These glasses can be split into the same two groups found by SEM-EDX analysis based on their calcium and iron levels. The vast majority are Type 2b and only one example of Type 2a was found (see **Fig. 5**). All of these objects are cut and incised 'unshaded/indeterminate' decorated and are multilayered objects. This fits with the pattern found by SEM-EDX analysis.

Type 3

These glasses have a mixture of both antimony and manganese. Colourless glasses of this composition have been identified previously.[34] No objects were identified as Type 3 from the SEM-EDX analysis. However, as mentioned above, due to the high detection limits for Sb_2O_3 of the SEM-EDX methodology, some glasses labelled as Type 2 on the basis of SEM-EDX results may in fact be Type 3. Where it is possible to determine the decoration style of Type 3 composition objects, they are all found to be of a similar style to the Type 2 multilayered glasses discussed above, i.e. cut and incised 'unshaded'.

The lead levels detected in all of these glasses make them likely to have been the product of a recycling process including the use of some lead-containing glasses.[35] Type 3 glasses have relatively high iron levels and low calcium levels (see **Fig. 5**). This makes them more similar to Type 2a, than Type 2b. If these glasses are the result of recycling of colourless glasses this may have involved the mixing of Type 2a glasses with Type 1 glasses. The number of objects made with Type 3 glass may be greater than those discerned through the XRF analysis. As mentioned above, it must be noted that the high detection limits for certain oxides analyzed by SEM-EDX may have resulted in some Type 3 glasses being defined as Type 2 (see Results: SEM-EDX above).

The recycling of colourless glass has been linked to difficulties in obtaining supplies of colourless glass in the north-western provinces, possibly as the Roman Empire's influence over this region waned.[36] However, the discovery of this compositional type in some of the gold glasses cannot be taken as conclusive evidence that they were made in the north-western provinces.

Conclusion

The major finding of this study is that the glass used to produce gold glass objects can be divided into compositional types. These types can be linked, in some cases, to the

Table 5 Summary of SEM-EDX and XRF results (BM = British Museum, CMA = Cleveland Museum of Art, CMG = Corning Museum of Glass)

Decoration	Form	Type 1	Type 2a	Type 2b	Type 3
Trailed	Multiple layers	1 (BM)	0	0	0
Brushed (with coloured base)	Multiple layers	1 (BM)	0	0	0
Cut and incised	Single layer	5 (BM)	0	0	0
(unshaded/ indeterminate)	Multiple layers	0	4 (BM)	13 (BM) 1 (CMG)	5 (BM)
Cut and incised	Single layer	2 (BM)	0	0	0
(shaded)	Multiple layers	1 (BM) 1 (CMA) 1 (CMG)	0	0	0

decorative techniques used on the objects. The chronological patterns suggested by Edward Sayre[37] and Harriet Foster and Caroline Jackson,[38] in combination with those by Daniel Howells,[39] suggest that Type 1 glasses may have been an earlier tradition than Types 2 and 3. The first stage of this pattern may see manganese overtaking antimony as the major decolouring ingredient used. This is followed by the use of recycled glass, probably as a result of a dwindling supply of new raw glass. This proposed chronology suggests that 'brushed' decorated, trail decorated, multilayered cut and incised 'shaded' and all single layered objects were all made before the cut and incised 'unshaded' objects (**Table 5**). While it is possible that Type 1 glass was being reworked later than the mid-4th century, the early dates suggested by Howells for some of the Type 1 objects gives the proposed chronology some added credence. [40]

If this chronology is correct, bearing in mind their relative proportions in museum collections, there seems to have been a switch from a small scale production of higher quality objects, to a higher scale production of lower quality items. Considerable social and cultural changes occurred in Europe during the Late Antique period. These changes may have led not only to the alterations in glass compositional types used, as discussed above, but also to the producers of gold glass objects altering their product to suit a greatly changing market. The number of consumers they supplied appears to have increased in number over time, coinciding with a reduction in the quality of items they consumed. This suggestion concurs with the views of Howells that, contrary to prior opinion, gold glass items were primarily owned by people of modest wealth and status.[41]

It can therefore be seen that the combination of analytical techniques employed in this project is a powerful tool in the identification of glass compositional types and can be used to test pre-established ideas based on the decoration and form of groups of glass objects. The future scientific analysis of similar objects will help to increase the database of glass compositions and test the suggested conclusions of this work.

Acknowledgements

This work would not have been possible without the support of many members of staff at the British Museum and others. There are some I would like to thank in particular: Dan Howells and Chris Entwistle (Department of Prehistory and Europe) for inspiring my interest in this subject and, along with Paul Roberts (Department of Greece and Rome), for allowing me to analyse the Museum's collection of gold glass. I would also like to thank Susan La Niece and Duncan Hook (Department of Conservation and Scientific Research), and Karen Webb, Ellen van Bork and Edward Oakley for their assistance in both analyzing the objects and discussing the results of this work.

Notes

1 D.T. Howells, 'Late Antique gold glass in the British Museum' D.Phil. Thesis, University of Sussex, 2010.

2 P. Filippini, 'Blown gold-sandwich glasses with gilt glass-trail inscriptions', in *Annales du 13e Congrès de l'Association Internationale pour l'Histoire du Verre, Pays Bas, 28 août-1 septembre 1995*, Amsterdam, A.I.H.V., 1995, 113–28; D. Whitehouse,'Glass, gold and gold-glasses', *Expedition* 38(2) (1996), 4–12, esp. 11.

3 See *inter alia*: F. Zanchi Roppo, *Vetri paleocristiani a fondo d'oro*, Ravenna, 1967; L. Faedo, 'Per una classificazione preliminare dei vetri dorati tardoromani', in *Annali della Scuola Normale superiore de Pisa Classe di Lettere e Filosofia* 8 (1978), 1025–70; H. J. Nüsse, 'Römische Goldgläser- alte und neue Ansätze zu Werkstattfragen', *Praehistorische Zeitschrift* 83 (2008), 222–56.

4 C.R. Morey, *The Gold-Glass Collection of the Vatican Library: With Additional Catalogues of other Gold-Glass Collections*, edited by Guy Ferrari, (Catalogo del Museo Sacro della Biblioteca Apostolica Vaticana, 4), Vatican City, 1959; Filippini (n. 2); Howells (n. 1).

5 Howells (n. 1).

6 Morey (n. 4), 5.

7 See ibid. for images of the objects in these collections.

8 R.H. Brill, *Chemical Analyses of Early Glass, Volume 2: The Tables*, Corning Museum of Glass, New York, 1999, 141.

9 See J.D. Cooney, 'The gold-glass Alexander plate', *The Bulletin of the Cleveland Museum of Art* 56(7) (1969), 253–61.

10 Brill (n. 8).

11 I.C. Freestone, 'Glass production in Late Antiquity and the Early Islamic period: a geochemical perspective', in M. Maggetti and B. Messiga (eds), *Geomaterials in Cultural Heritage* (Geological Society, London, Special Publications, 257), London, 2006, 201–16.

12 Ibid., 206.

13 Y. Gorin-Rosen, 'The ancient glass industry in Israel: summary of finds and new discoveries', in M.-D. Nenna (ed.), *La route du verre: ateliers primaires et secondaires de verriers du second millénaire av. J.-C. au Moyen Age* (Travaux de la Maison de l'Orient Méditerranéen, 33), Lyon, 2000, 49–64; I.C. Freestone, Y. Gorin-Rosen and M.J. Hughes, 'Primary glass from Israel and the production of glass in Late Antiquity and the Early Islamic period', in Nenna *ibid.*, 65–83.

14 M.J. Baxter, H.E.M. Cool and C.M. Jackson, 'Further studies in the compositional variability of colourless Romano-British vessel glass', *Archaeometry* 47(1) (2005), 47–68; P. Degryse and J. Schneider, 'Pliny the Elder and Sr-Nd isotopes: tracing the provenance of raw materials for Roman glass production', *Journal of Archaeological Science* 35(7) (2008), 1993–2000; J.F. Healy, *Pliny the Elder on Science and Technology*, Oxford, 1999, 355.

Table 6 Non-normalized SEM-EDX results for all glasses analyzed in this study in wt% (bdl = below detection limit, * = also analyzed by XRF, S = shaded, U/I = unshaded/indeterminate, L. = number of glass layers on the object, Al. = number of layers analyzed)

BM Registration Number	Decoration	Form	L.	Al.	Na_2O	MgO	Al_2O_3	SiO_2	Cl	K_2O	TiO_2	CaO	MnO	FeO	Sb_2O_3	Total	Type
OA.858	Trailed	Multiple layers	2	1	19.8	0.36	1.64	71.8	1.55	0.40	0.08	5.17	bdl	0.25	0.67	101.24	1
1859,0618. 5*	Cut and incised (S)	Single layer	1	1	18.9	0.50	1.69	69.2	1.31	0.37	0.08	6.14	bdl	0.28	0.26	99.08	1
1859,0618. 4*	Cut and incised (S)	Single layer	1	1	19.2	0.51	1.74	70.4	1.32	0.40	0.06	6.18	bdl	0.29	0.33	100.03	1
1854,0722.8	Cut and incised (U/I)	Single layer	1	1	19.4	0.45	1.65	69.9	1.56	0.33	0.10	5.25	bdl	0.31	0.62	99.61	1
1859,0618. 3	Cut and incised (U/I)	Single layer	1	1	19.3	0.52	1.74	68.7	1.36	0.45	0.07	6.20	bdl	0.33	0.37	99.05	1
OA.864	Cut and incised (U/I)	Single layer	1	1	19.7	0.49	1.82	70.2	1.38	0.45	0.07	6.38	0.11	0.35	0.51	101.40	1
OA.867	Cut and incised (U/I)	Single layer	1	1	20.0	0.47	1.76	68.5	1.49	0.47	bdl	5.79	0.11	0.36	0.47	99.40	1
S120	Cut and incised (U/I)	Single layer	1	1	19.6	0.47	1.72	68.10	1.38	0.58	0.08	6.25	bdl	0.43	0.59	99.21	1
S317	Cut and incised (U/I)	Single layer	1	1	19.8	0.46	1.76	68.6	1.45	0.47	bdl	5.75	0.16	0.37	0.43	99.23	1
1859,0618. 1	Cut and incised (U/I)	Multiple layers	2	1	19.6	0.69	2.11	67.6	1.36	0.46	0.06	5.95	0.86	0.53	bdl	99.24	2a
1863,0727.7	Cut and incised (U/I)	Multiple layers	2	2	18.0	0.73	2.38	67.5	1.39	0.53	0.11	6.48	1.02	0.54	bdl	99.40	2a
1878,1101. 305	Cut and incised (U/I)	Multiple layers	2	1	18.1	0.76	2.60	67.2	1.24	0.59	0.13	6.80	1.04	0.65	bdl	99.07	2a
1863,0727. 2	Cut and incised (U/I)	Multiple layers	2	1	15.4	0.56	3.19	70.5	0.86	0.74	0.12	8.39	1.24	0.39	bdl	101.38	2b
1854,0722. 6	Cut and incised (U/I)	Multiple layers	2	1	15.3	0.67	2.77	70.9	1.15	0.57	0.06	8.69	1.05	0.39	bdl	101.54	2b
1854,0722. 5	Cut and incised (U/I)	Multiple layers	2	1	16.4	0.73	3.11	68.9	1.07	0.71	0.09	9.02	1.23	0.41	bdl	101.61	2b

Table 7 Results of semi-quantitative XRF analysis. Numbers quoted are ratios of peak areas for the relevant element, divided by that for silica, see Methodology (* = also analyzed by SEM-EDX, S = shaded, U/I = unshaded/indeterminate, Layers = number of glass layers on the object, Anal.=number of layers analyzed)

BM Registration Number	Decoration	Form	Layers	Anal.	Mn/Si	Sb/Si	Ca/Si	Fe/Si	Pb/Si	Type
1859,0618.4*	Cut and incised (S)	Single layer	1	1	0.04	0.58	1.55	1.08	0.11	1
1859,0618.5*	Cut and incised (S)	Single layer	1	1	0.03	0.58	1.45	1.11	0.07	1
1890,0901.1	Brushed (coloured base)	Multiple layers	2	1	0.14	0.71	1.60	2.00	0.36	1
1898,0719.2	Cut and incised (S) (coloured base)	Multiple layers	2	1	0.19	0.56	1.54	1.31	0.18	1
1863,0727.1	Cut and incised (U/I)	Multiple layers	2	2	2.26	0.09	1.54	2.30	0.07	2a
1854,0722.11	Cut and incised (U/I)	Multiple layers	2	2	2.52	0.01	2.16	1.28	0.02	2b
1863,0727.3	Cut and incised (U/I)	Multiple layers	2	2	2.19	0.03	1.95	1.07	0.01	2b
1863,0727.5	Cut and incised (U/I)	Multiple layers	2	2	2.80	<0.01	2.20	1.42	0.03	2b
1863,0727.6	Cut and incised (U/I)	Multiple layers	2	2	2.42	<0.01	2.34	1.17	0.02	2b
1863,0727.8	Cut and incised (U/I)	Multiple layers	2	2	3.42	<0.01	2.47	1.32	0.01	2b
1863,0727.9	Cut and incised (U/I)	Multiple layers	2	2	2.19	<0.01	2.04	1.28	0.03	2b
1863,0727.10	Cut and incised (U/I)	Multiple layers	2	2	2.21	0.01	2.02	1.17	0.02	2b
1863,0727.12	Cut and incised (U/I)	Multiple layers	2	2	2.30	0.01	2.18	1.28	0.03	2b
1863,0727.13	Cut and incised (U/I)	Multiple layers	3	3	2.29	0.02	2.31	1.25	0.02	2b
1870,0606.12	Cut and incised (U/I)	Multiple layers	2	2	2.44	<0.01	2.14	1.07	<0.01	2b
OA.856	Cut and incised (U/I)	Multiple layers	3	3	1.73	0.37	1.78	2.25	0.14	3
1854,0722.3	Cut and incised (U/I)	Multiple layers	2	2	1.91	0.30	1.70	3.05	0.16	3
1854,0722.4	Cut and incised (U/I)	Multiple layers	2	2	1.70	0.52	1.73	2.61	0.19	3
1863,0727.11	Cut and incised (U/I)	Multiple layers	2	2	1.73	0.29	1.77	2.44	0.12	3
1886,1117.331	Cut and incised (U/I)	Multiple layers	2	2	1.80	0.25	1.26	1.99	0.13	3

15 H.E. Foster and C.M. Jackson, 'The composition of "naturally coloured" late Roman vessel glass from Britain and the implications for models of glass production and supply', *Journal of Archaeological Science* 36 (2009), 189-204; H.E. Foster and C.M. Jackson, 'The composition of late Romano-British colourless vessel glass: glass production and consumption', *Journal of Archaeological Science* 37 (2010), 3068–80, esp. 3075.
16 E.g. C.M. Jackson, 'Making colourless glass in the Roman period', *Archaeometry* 47 (4) (2005), 763–80; S. Paynter, 'Analyses of colourless Roman glass from Binchester, County Durham', *Journal of Archaeological Science* 33 (2006), 1037–47; A. Silvestri, G. Molin and G. Salviulo, 'The colourless glass of *Iulia Felix*', *Journal of Archaeological Science* 35 (2008), 331–41; Foster and Jackson 2010 (n. 15).
17 Foster and Jackson 2010 (n. 15).
18 Ibid., 3070–3, for a more detailed discussion of these groups.
19 Jackson (n. 16), 764.
20 Ibid.; E.V. Sayre and R.W. Smith, 'Some materials of glass manufacturing in antiquity', in M. Levey (ed.), *Archaeological Chemistry: a Symposium*, Philadelphia, 1967, 279–311, esp. 293–4.
21 Foster and Jackson 2010 (n. 15), 3074.
22 See Paynter (n. 16), 1048, fig. 10 for a useful summary.
23 J. Bayley, 'Qualitative analysis of some of the beads', in V.I. Evison, *The Buckland Anglo-Saxon Cemetery*, London, 1987, 182–9, esp. 182.
24 Ibid.
25 Foster and Jackson 2010 (n. 15), 3073.
26 Jackson (n. 16), 767, fig. 1.
27 Howells (n. 1).
28 See *inter alia*: E.V. Sayre, 'The intentional use of antimony and manganese in ancient glasses', in F.R. Matson and G. Rindone (eds), *Advances in Glass Technology, Part 2*, New York, 1963, 263–82; Sayre and Smith (n. 20); Jackson (n. 16); Foster and Jackson 2010 (n. 15).
29 Freestone (n. 11), 206.
30 Howells (n. 1).
31 Brill (n. 8).
32 Ibid., 141.
33 Sayre (n. 28); Sayre and Smith (n. 20); Jackson (n. 16); Foster and Jackson 2010 (n. 15).
34 Sayre (n. 28); Jackson (n. 16); Silvestri *et al.* (n. 16); Foster and Jackson 2010 (n. 15).
35 Foster and Jackson 2010 (n. 15), 3073.
36 Sayre (n. 28); Foster and Jackson 2010 (n. 15), 3074.
37 Sayre (n. 28).
38 Foster and Jackson 2010 (n. 15).
39 Howells (n. 1).
40 Ibid.
41 Ibid.

Chapter 15
Late Antique Glass Pendants in the British Museum

Chris Entwistle and Paul Corby Finney

Introduction

The 90 Late Antique glass pendants from the British Museum's collection[1] which are the subject of this paper belong to a rather neglected group of largely amuletic material. They have tended to be overlooked either in favour of their earlier cousins, the so-called 'magical gems', or their near contemporaries, the much less numerous group of Early Christian gems.[2] Despite drawing upon a wide repertoire of Graeco-Roman, Graeco-Egyptian, Jewish and Early Christian motifs, these pendants have not been assimilated into mainstream analyses of magical amulets (or jewellery) of the 4th century. This was a particularly fertile period for 'magic' which, whilst seeing a decline in the usage of gemstones as amulets, nevertheless saw an apparent increase in Syria and Palestine in the production of amulets in other materials exemplified, for instance, by the proliferation of *defixiones*.[3] Indeed one conclusion that can be drawn from an analysis of these glass pendants, which are found throughout the Mediterranean and its hinterlands, is that it is no coincidence that they appeared so frequently at a time when most magical and Early Christian gems had seemingly declined (insofar as we can tell from the limited archaeological evidence)[4]: in other words, they filled a gap in the 'magical' market. Their emergence was, of course, notwithstanding of outright hostility from the Church and secular authorities.[5] By drawing together many of the isolated and obscure publications which deal with this material, this paper aims at a more integrated analysis of the pendants' morphology, typology, iconography, function, distribution and source of production.[6]

A brief word needs to be said at the outset concerning terminology. Some confusion has been created by the application by certain scholars of the German word 'glaspasten' to describe these pendants.[7] The use of this term in an English context is highly misleading. The term 'glass paste' has a quite specific meaning and is derived from the work of the 18th-century sculptor James Tassie (1735–99), who made copies of ancient jewellery in this medium.[8] His whole process involved the careful casting of glass and not free-hand stamping. Neither should these pendants be confused with another class of 4th-century material with which they are sometimes grouped – 'trilobitenperlen' (spacer beads) (**Pl. 7**). Although these beads share certain iconographic motifs with the pendants they are, like the Tassies, made using a completely different technique and have a different function.[9] They tend to be produced in opaque black, dark green or brown glass and are doubly perforated for suspension or attachment. The beads were probably wound around a double-pronged rod and, while hot, one side would have been pressed into a mould or stamped with a die. These objects reflect the technology of beads not pendants.

Manufacture and morphology

The pendants described in the catalogue accompanying this paper are remarkably homogeneous in both appearance and technique. They take the form of simple glass discs with a central impressed area, rolled rim and suspension loop. A number of stages are evident in their manufacture. First, a piece of cullet was affixed to the end of a metal rod or wire. Further similar pieces were then added by tongs as the first

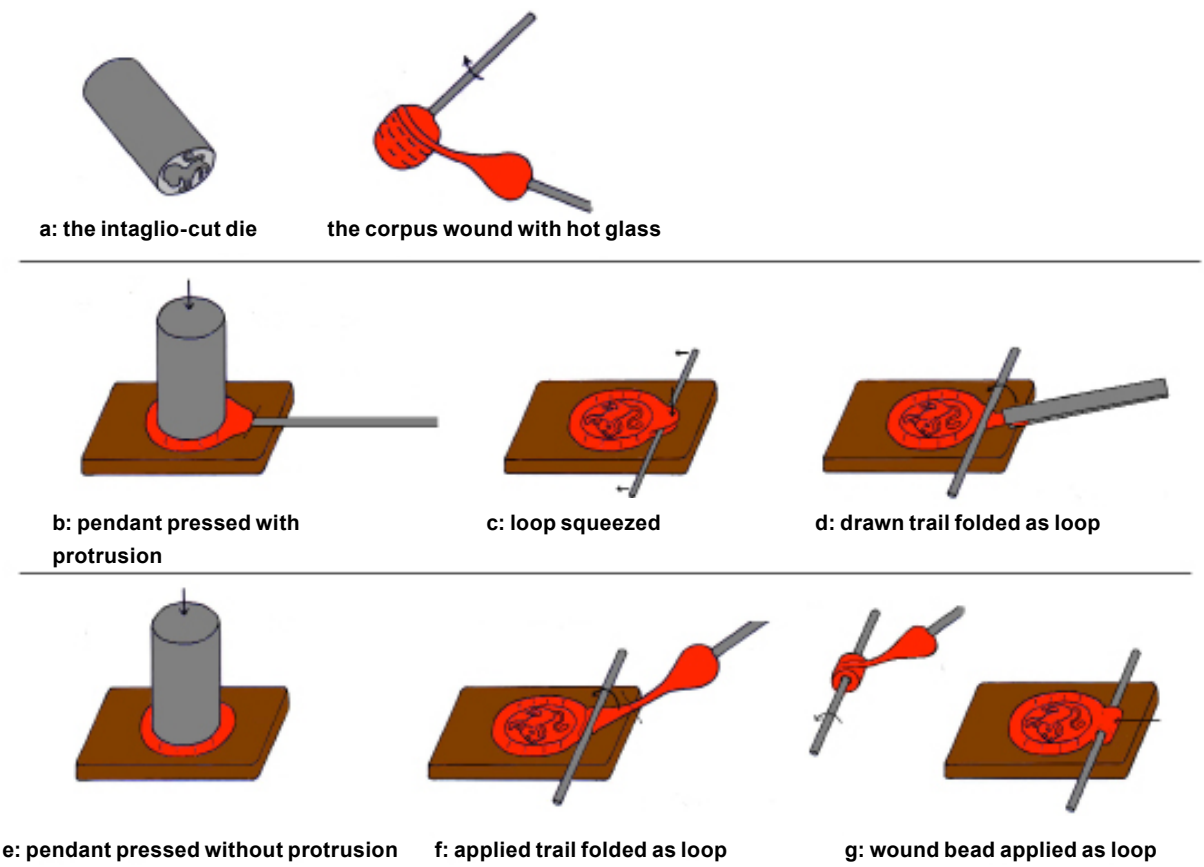


Plate 1a–g The various techniques by which the pendants' suspension loops could have been made (courtesy of Rosemarie Lierke)

piece melted and when the gob of molten glass had reached the required state it would have been withdrawn from the flame and placed either on a flat marble, metal or, less likely, wooden surface. Then the suspension loop would have been made before an intaglio die bearing the relevant design was pressed into the centre of the glass gobbet. Downward pressure from the die face would cause the gob to flatten outwards forming the rolled rim as an edge. Alternatively at the end of the second stage the die could have been impressed first and then the loop made. The reverses are always plain.

The most significant technical and morphological variation to be found on the pendants is with regard to the manufacture of their suspension loops (many of which are broken). Rosemarie Lierke has suggested a number of different methods which could have been employed in their construction (**Pl. 1**):[10]

1. A gob of molten glass was melted with a slight protrusion (or such a protrusion was applied to the molten glass). While the die was pressed into the main body of the molten glass, a round stick or thick wire was pressed horizontally just above the supporting plate against the tip of the protrusion. The glass of the protrusion was further manipulated by drawing and squeezing together with tweezers to fully enclose the stick/wire thus forming a loop (**Pl. 1a–c**).[11]
2. A gather was made from the edge of the semi-molten glass and the drawn trail folded over a wooden core or piece of wire to form the suspension loop. The trail could be pulled from either over or under the core/piece of wire (**Pl. 1d**).
3. The pendant was pressed without a protrusion and a short hot glass trail – perhaps already flattened – either fused perpendicular with its middle to the already impressed glass disc, and both ends manipulated as above around a round stick/wire, or a trail was fused with its end to the rim of the disc and folded around the stick (**Pl. 1e–f**).
4. In the final technique a prefabricated glass bead could have been fused to the rim of the impressed disc as practised on pre-Roman head beads and pendant beads (**Pl. 1g**).

As these differing techniques imply it is no surprise that within the known corpus of pendants various types of loop have been identified. Dan Barag, for instance, divides the 52 examples in the Israel Museum's collection into three distinct groups:[12] Type A, which he dates to the second half of the 4th century through to the early 5th century, is defined by flattened suspension loops, designs executed along a vertical axis and 'good workmanship'; Type B, which is dated to the late 4th and 5th centuries, differs in having 'rounded, convex and annular' hoops, variations in the die axis, and displaying inferior workmanship; the final category, which he dates to the period around AD 450–550, is distinguished by large, annular hoops, irregular sized discs, and such inattention paid to the die axis that it can lead to the design extruding beyond the borders of the pendant. Whilst acknowledging that, in some respects, these are useful technical differentiations to establish, one would add the rider that 'quality of workmanship' is rarely a useful diagnostic tool where matters of chronology are concerned and that the archaeological evidence does not justify dating those

Table 1 Die sizes of pendants in the British Museum

8mm	9mm	10mm	11mm	12mm	13mm	14mm	15mm	16mm	17mm	18mm
1	0	3	7	13	25	23	14	5	1	1

Table 2 Multiple and single dies in other collections

collection	number of examples	number of different dies
Israel Museum, Jerusalem	53	53 single dies
Musée National, Damascus	49	1 multiple die (10 examples), 39 single dies
Corning Museum of Glass	43	1 multiple die (3 examples), 40 single dies
Borowski Collection, Israel	40	2 multiple dies (5 examples), 35 single dies
Louvre, Paris	35	1 multiple die (3 examples), 32 single dies
Sternberg Collection, Zurich	27	27 single dies
Archaeological Museum, Split	26	26 single dies
Museo Archeologico Nazionale, Aquileia	17	17 single dies
Musée d'art et d'histoire, Geneva	13	13 single dies

pendants with 'large annular hoops', for instance, exclusively to the period from the mid-5th to the mid-6th century.

It is certainly true, however, that there is a quite distinct sub-group of loops which are larger, slightly twisted and more rounded in profile. Twenty-one examples have been identified in the Museum's collection, twelve of which can be divided into three further sub-types defined iconographically: three examples with Daniel and the lions (cat. nos 34–6), three with stylite saints (cat. nos 38–40), and six with the figure of a lion moving to right with frontal head and a star within a crescent moon above (cat. nos 66–71). The probability that these 21 examples form a discrete group is reinforced by two other factors: first, many seem to share the same dies and, second, they are largely manufactured in the same colours (mainly blue and green), colours which diverge from the typical amber or yellow/brown colour employed on the majority of surviving pendants. Whilst it is undoubtedly true that those pendants with representations of stylite saints must be later than the 4th century – Simeon Stylite the Elder, the first stylite saint, died in AD 459, the Younger in AD 592 – there is no reason why the others should be dated later: in all likelihood they just represent the products of a different workshop.[13]

Dies

By measuring the diameter of the impressed surface one can gain some idea of the range of die sizes employed on the pendants, although, because it is difficult to position callipers at the bottom of the stamped impression because of the rolled rim, the figures reproduced below should not be regarded as highly accurate. The dies employed on the Museum's pendants are given in **Table 1** above and range in diameter size from 8mm to 18mm.

However, the majority (75 out of the 90), range between 12mm to 15mm, slightly larger in diameter than most contemporary gemstones employed as bezels in rings. No dies for pendants have, to the best of my knowledge, survived, but like coin dies and *bullouteria* they were probably made of copper-alloy (bronze, brass or gunmetal) or iron, lead being too soft a material for prolonged use. Because many of the incuse surfaces are worn, it is difficult to ascribe individual pendants to the same die unless in circumstances where the images are particularly clear and the incuse diameters almost identical. Out of the 90 examples in the Museum's collection there are probably only 24 which share the same dies: these include cat. nos 15–16 (Nike), 19–20 (opposing male and female busts), 25–6 (Christ and apostles) 30–2 (shepherd-*kriophoros*), 34–5 (Daniel and the lions), 38–9 (stylites), 46–7 (lion), 52–3 (lion), 55–6 (lion), and 66–8 and 70–1 (lions with frontal faces). With regards to the largest category, the lion pendants, the vast majority come from individual dies. The relatively high percentage of single dies in the Museum's collection is also reflected in the nine largest museum and private collections in Europe and the Near East as shown in **Table 2** above, although these figures should be treated with a degree of caution as in some publications the incuse diameters are not given or the illustrations of the individual pieces are not of the highest quality. It is also quite clear that in some instances the same die was employed on pendants in completely different collections, thus making an estimate of how many different dies were employed extremely difficult.

Nevertheless, it is apparent that a large number of dies, probably numbering in the hundreds, must have been in circulation at any one time. This raises the question not only as to who made them, but where they were made and how

Table 3 Pendant colours in the major collections (BM=British Museum, I=Israel Museum, D=Damascus, C=Corning, B=Borowski, L=Louvre, Z=Zurich, S=Split, A=Aquileia, G=Geneva)

	BM	I	D	C	B	L	Z	S	A	G
Amber	37						15			
Brown	9			1	1					
Light brown		5			9					
Yellowish brown		28		14						
Chestnut						2				
Yellow	3		1			12			15	13
'Honey' yellow			27							
Brownish yellow			3	7						
Greenish yellow				2						
Dark blue	4	4	6	2	2		1			
Blue	10	2	9	2	2	7	5		1	1
Greenish blue				2						
Greyish blue		1								
Green	1	5		1	3	8	5		1	
Bluish green	1		3	3	1	3				
Light green	4	1								
Brownish green				1	15					
Olive green				1	5					
Yellowish green		3		7		2				
Emerald green										1
Purple		1		1		1				
Opaque black		1			1					
Turquoise	2									
Violet						1				
Indeterminate		1			1	1				

they were applied. What is abundantly clear from our knowledge of the structure of the glass industry in the Levant (see below), is that it is highly unlikely that the dies were applied at the primary source of the glass manufacturing process, that is the firing furnaces. The dies must have been applied at secondary workshops situated in the major urban centres in Syria/Palestine. Are we looking at one centre or different workshops scattered throughout the region? In this respect it is worth noting the iconographic similarities between the pendants and in particular the

Early Christian gems, as well as some coin types. The narrative scenes concerned with salvation that dominate the iconographic repertory of Early Christian gems – Adam and Eve, Noah, Abraham's sacrifice, Daniel and the Good Shepherd – are precisely those which are found on the pendants. If multiple workshops were involved in the manufacture and distribution of these pendants then this iconographic homogeneity could be explained by the presence of widely circulated pattern/model books. Alternatively, it is tempting to hypothesize that there was one hierarchical workshop where the most talented *scalptores* made the dies for coins, the next in rank intaglios, and finally at the bottom of the chain, possibly apprentice craftsmen employed in the manufacture of simple mass-produced dies such as those used on the pendants. The link between certain coin types and the images used on some of the pendants at least points to an awareness of the numismatic genre as an iconographic source, even if it was not a direct inspiration. The only imperial mint to exist in the Levant in the 4th century was at Antioch. Could a workshop/s situated here, rather than further south at Jerusalem for instance, be the source of the dies for the pendants?

Colour

The pendants in the Museum's collection were manufactured in a variety of colours including amber, yellow-brown, light and dark greens and blues, as well as turquoise. Descriptions of translucent colours are, of course, notoriously subjective and numerous factors can affect colour definition: the chemical components in a batch,[14] variations in the thickness of the glass and the intensity and angle of the light source. **Table 3** displays the range of colours (24 in all) employed in describing those pendants in the major collections. Nowhere is the difficulty in describing these colours 'objectively' more apparent than when it comes to the predominant colour in which these pendants were produced. For instance, what is categorized here as 'amber' is alternatively described by others as brown, yellowish brown, light brown, chestnut brown, yellow, 'honey' yellow, brownish yellow or brownish green!

Nevertheless, it would be foolish to ignore colour totally as a possible diagnostic chronological tool and the desirability of building up a colour database of all pendants, which is not dependant on a methodology as limited as personal observation, is obvious. To this end the CIE L*A*B* technique of defining colour was employed using a Konica-Minolta CM2600d spectrophotometer with a small measurement aperture (3mm).[15] CIE L*A*B* colour is designed to approximate to human vision and aims at perceptual uniformity. In a uniform colour scale the differences between points plotted in the colour space correspond to visual differences between the colours plotted. This methodology is described in more detail in Appendix A where the results of analyses of the pendants in the Museum's collection are tabulated. L*A*B* values are also provided for each colour in the Munsell palette.

These results confirm that approximately two-thirds of the pendants in each of the collections in **Table 3** fall within a yellow-brown register, which is described here in most

Plate 2 Glass token with the figure of an ibis, Egypt, 2nd–3rd century (?). British Museum, London (PE 1983,1108.40)

cases as amber. This raises a number of questions: how unusual is this colour within the corpus of Late Antique glass emanating from the eastern Mediterranean? Was it the result of a deliberate attempt by the glass-makers to reproduce this hue or was it entirely accidental? Is there a relationship between this yellow-brown/amber colour and certain iconographic types which may have contributed to the amuletic properties of the pendants? Although vessels made in amber glass are known in the Levant,[16] it is striking that this colour is almost entirely absent from the two other categories of mass-produced stamped glass products which have survived from Late Antiquity. The first is a series of glass discs, probably of Egyptian manufacture, which have been variously interpreted as tokens, gaming pieces or counters of some description.[17] They are stamped on one or both sides with the figure of an ibis (**Pl. 2**), Herakles and Nike (**Pl. 3**), or a bust of Isis juxtaposed with a personification of the Nile (**Pl. 4**). The most consistent iconographic parallels for these figures are found on coins struck at the mint of Alexandria from the period of its creation by Augustus to its reorganization by Diocletian in AD 296.[18] Most probably date to the 2nd and 3rd centuries. Of the over 200 known examples none is manufactured in amber or brown glass: green and blue are the predominant colours. The second category is Early Byzantine glass weights.[19] These also take the form of glass discs with similar rolled rims (but without suspension loops) and they too are stamped with monograms and inscriptions relating to their issuing authorities, the eparchs of Constantinople and the major provincial centres (**Pl. 5**). They seem to have originated early in the reign of Anastasius (AD 490–518), in other words

Plate 3 Glass token with a bust of Herakles on one side, Nike on the other, Egypt, 2nd–3rd century (?). British Museum, London (PE 1983,1108.25)

Plate 4 Glass token with a bust of Isis on one side, the personification of the Nile on the other, Egypt, 2nd–3rd century (?). British Museum, London (PE 1983,1108.9)

Plate 5a–b Two glass weights, one with a box, the other with a cruciform monogram, Eastern Mediterranean, 6th–7th century. British Museum, London (PE 1980,0611,12 and PE 1987,0703,8)

at a time when the majority of the pendants had ceased to be made. Like the Egyptian tokens it is noteworthy that the amber/yellow brown colour is almost totally absent from the known corpus: of the 174 examples in the British Museum's collection only one is produced in amber glass, with dark blue, blue and blue-green the main colours employed.

The comparative rarity of the colour is confirmed by even the most cursory survey of those sites in the Levant from which large quantities of glass have been uncovered. There is not the space here to undertake a detailed survey, but the site of Jalame to the south-east of Haifa is instructive in some respects.[20] Originally composed of a large villa with olive and wine presses, around AD 351 the site saw the construction of a glass factory composed of a furnace, sorting floors and a dump. During the four seasons of excavations in the 1960s thousands of glass vessel fragments and tons of glass cullet and waste were found which had been produced at a time and in an area where the majority of the Levantine pendants have been found. The fragments represented a variety of vessel forms found throughout Galilee in the Late Roman period. Whilst one should be wary of drawing conclusions from one site only, it is noticeable how little amber glass was found at Jalame,[21] the prevalent colours being blue-green in various shades, green and yellowish-green, with purple, colourless, brown and olive green being less common. An almost total absence of this colour is also noticeable among the numerous glass finds at the more recent excavations at the Petra Church[22] and at the monastery site of Deir 'Ain 'Abata in the Ghor es-Safi, Jordan.[23]

The possibility that this colour was produced accidentally also needs consideration. Amber does not seem to have been the easiest of colours for the ancient glassworker to deliberately reproduce. The colours of most Levantine glasses derived from their interactions with the elements iron, manganese and antimony, whereas the colour amber is most likely due to the 'presence of the ferri-sulphide chromophore, a complex which forms in the glass under strongly reducing conditions. These result in the presence of reduced sulphide, S^- ions, in the coordination polyhedron of Fe^{3+} and this complex generates the amber colour.'[24] Because of the need to maintain strongly reducing conditions 'amber glass is therefore likely to represent material used directly from the primary glassmaking furnaces without intermediate phases of melting'.[25] Fragments of what have been described as yellow-brown glass have been found in some Levantine glass furnaces, for instance at Beit Eli'ezer, and it is worth recalling how enormous some of these firing and melting chambers were: the 17 uncovered at Beit Eli'ezer were capable of producing hundreds of tons of glass,[26] and the largest piece of glass discovered in a cave at Beit She'arim was a slab weighing 8.9 tons. **Table 4** lists the weights of the 89 relevant pendants in the Museum's collections:[27] they range from 0.8g to 3.4g with a mean weight of 1.67g. If one only includes the 52 examples with complete suspension loops then the mean rises to 1.85g. Taking this higher figure as the rough average weight for the pendants, the Beit She'arim slab alone would yield very approximately 4,500,000 pendants!

It may be that the amber colour was prized simply for its rarity or subtle hue rather than for any perceived amuletic properties. Unlike magical gems, where both the *Papyri Graecae Magicae* (*PGM*) and the *Orphic Lithika*, for example, make clear the fundamental importance of the colour of certain stones and how the efficacy of the images/spells engraved on them is both determined and enhanced by their colour, there is no literary evidence to suggest that the colour amber was regarded as a prophylactic one.[28] Nor does there seem to be any specific correlation between image and colour on the pendants: pagan, Jewish and Christian images are all employed seemingly at random on the amber-coloured pendants. Perhaps the colour was ultimately coveted for what Ann Terry has described as its 'distinctive reflective and colouristic properties'.[29]

Use

These objects have traditionally been described in the literature as amulets and the archaeological evidence suggests that a large number of them indeed have an apotropaic function. How then were they worn? The majority of the known contexts for the pendants is funerary: in graves (both inhumation and cremation), tombs and sarcophagi of various types, discovered both in cemeteries and isolated burials.[30] It is clear from analyzed skeletal remains that pendants were worn by both men, women and children. The associated grave goods nearly always comprise, *inter alia*, beads or other traditional spacers employed in necklaces. It is also apparent from funerary contexts that these pendant amulets could be worn singly or in multiples with particular combinations being repeated. This is true of both European and Middle Eastern find-spots. Of the former, three of the most important examples are the

Table 4 Weights of individual pendants in the British Museum's collection

0.8g	1.0g	1.1g	1.2g	1.3g	1.4g	1.5g	1.6g	1.7g	1.8g	1.9g	2.0g	2.1g	2.2g	2.3g	2.4g	2.5g	3.1g	3.2g	3.4g
1	3	4	5	10	9	11	6	7	6	4	3	2	5	2	2	4	2	1	1

cemetery sites of Ságvár and Keszthely-Dobogó in Hungary and Mihălăşeni in Romania. Excavations at the site of Ságvár were conducted between 1937 and 1942 and revealed 342 graves.[31] Grave 340 contained the skeleton of a child together with various grave goods and a glass pendant stamped with a horse.[32] The pendant was found contiguous to the neck together with an amber bead; around the neck were found a further nine beads. Slightly differently positioned were two pendants found in Grave 56 at Keszthely-Dobogó.[33] This again was a child burial and contained among other items two glass pendants, one with a lion, the other with a frog and the inscription ZOHN; in conjunction with these were two further undecorated glass pendants, all found just under the jaw of the skull. The richest of the grave finds was that at the site of Mihălăşeni.[34] Grave 123 there constituted a female burial containing a pair of silver *fibulae*, a bronze *fibula* and other high status grave goods. Immediately below the fractured jaw-bone were the remains of a necklace composed of 22 pierced glass beads and three pendants. The pendants featured a frog, a female bust and the inscription NIKE, and Daniel between the lions.

Similar assemblages of pendants have been found in a number of tombs in Israel. A stone cist excavated at Lohamei HaGeta'ot contained a disturbed skeleton with 14 glass and jade beads together with two pendants both stamped with lions to right.[35] Evidence for more than two or three pendants being worn on a single necklace is perhaps suggested by the finds from the tombs at Tarshihā.[36] A total of eight pendants were found here. Although one came from the vestibule area, the remaining seven – five pendants with a lion to right and a star and crescent in the field, one with a tortoise and one with a menorah – all came from Tomb 1 together with a 108 beads and 11 spacers. The five lion pendants are described by Iliffe as part of one string or necklace. The two necklaces with the most surviving pendants, however, do not unfortunately come from excavated contexts.The first, which was acquired in Paris in 1912 by the Musée Curtius, Liège, is 32cm in length.[37] It is constructed of 38 glass beads – globular, truncated and annular – with five pendants representing a frog, a lion to right with crescent moon and star, a frontal figure holding an animal in each hand, and two with a lion with frontal head moving to right. Even more pendants are found on the second example which is preserved in the collection of the Staatlichen Kunstsammlungen, Kassel (**Pl. 6**):[38] this is constructed of 65 blue-black beads interspersed with ten pendants: four of which are stamped with the figure of a roaring lion to right, four with an unidentified quadruped with a star and crescent moon, a frog/tortoise, and finally an orant figure possibly representing the Good Shepherd or Daniel amongst the lions.

Plate 6 Glass necklace with ten pendants, Levant, 4th century. Staatlichen Kunstsammlungen, Antikenabteilung, Kassel, Inv. no. G 142

Although the archaeological evidence suggests that the vast majority of these amulets were employed as necklace pendants a few were, however, worn as earring adornments. Three earrings excavated from tombs at Dali (Idalium) in Cyprus are now in the Metropolitan Museum of Art, New York.[39] All three are formed of simple loops of gold wire with twisted terminals; from each hang, respectively, three amber glass pendants with a lion with striated mane and star and crescent, a lion moving to right, and finally a pouncing lion moving to left. Further evidence that the pendants could be suspended from earrings is provided by an example found in a tomb in Amiens, France (cat. no. 22).[40] Although it is conceivable that these pendants could have been strung and worn as spacers on bracelets, this seems unlikely given that glass bracelets stamped with motifs such as the lion and menorah were already manufactured in this period.[41] Nor is it likely that, as with some magical gems with medical properties which were worn close to the afflicted organ, they would have been under layers of clothing as they would have been vulnerable to breakage and thus likely to pierce the wearer's skin.

Amuletic intent

In 1927 the Swedish naturalist, Gustavus A. Eisen, classified objects of the type catalogued here as 'the principal amuletic objects of the Constantinian period', a theory that scholars have largely ignored.[42] Eisen did not specify what he meant by 'the Constantinian period', whether just the emperor's sole rule of the Empire (AD 324–37) or the continuation of his policies by his dynastic successors for a quarter century after Constantine's death. Either way, the appearance of glass pendants and Constantinian rule do overlap. It is unclear if Eisen meant to imply that the imperial household was involved in the production of these objects. If this was intended it was a mistake – the Constantinians played no patronage role in the manufacture of these modest little

objects. Eisen also did not specify territorial parameters of production and distribution. Based on what we know at present, it seems that the 4th-century appearance of glass pendants was mostly a localized Levantine phenomenon, limited to Late Roman Syria-Palestine (see below). In sum, Eisen was right about the 4th-century date of production. But he was wrong to connect production with the Constantinian household, if that was his intention, and he offered nothing on the geographical locus of manufacture or the patterns of distribution, both of which were mainly east Mediterranean. Of course the big question which Eisen did raise and that still remains unresolved is this: when 4th-century buyers acquired a stamped glass pendant, did they think they had acquired a piece of jewellery, or an amulet? Or perhaps both, two for the price of one?

The jewellery component is paramount. These pendants are objects meant to be shown and worn as display pieces, either strung together with spacers as necklaces or as an alternative, fastened to a wire and worn as earrings. The different colours of the glass will have enhanced the decorative effect, and perhaps the honey/amber colouration (which seems to have been the standard) will have prompted associations with gold. Glass pendants are unlike inscribed (and other) amulets that were hidden, tied to body parts beneath garments. This would not have worked for glass pendants – they would have fractured too easily, abrading or piercing the skin. To repeat, glass pendants were clearly on one level display pieces, ornaments designed to flatter the neck and head, in a word jewellery.

Since 1951, the year in which Bonner released his masterpiece *Studies in Magical Amulets*, any and all discussion of amulets manufactured and distributed in Late Antiquity has centred on the primary type introduced by Bonner (or more correctly, reintroduced by him).[43] Bonner, Hopfner, Michel (and many others) have focused on small hardstone oval bezels, engraved on both sides with devices that include figural and non-figural images, words, letters and charaktēres.[44] The comparison between objects of this type and glass pendants understood as amulets is inevitable, but misguided. There is only one compelling commonality. Glass pendants were 'tied on' or 'tied around', fastened and attached. So were some inscribed hardstone amulets and so were inscribed extant Late Antique metal amulets.[45] To describe amuletic objects Pliny uses the verbs *alligare* (*Nat. Hist.* 24.94) and *infigere* (*Nat. Hist.* 29.83) which render Greek περιάπτειν.[46] If Pliny the peripatetic encyclopaedist had seen glass pendants during his government service in Syria-Palestine, on the criterion of their being *alliigatus*, he would doubtless have included them in his amuletic lexicon, but alas they came too late or he too early.

The other (more important) feature of engraved hardstone amulets, namely their numinous or sacred character, must be mentioned briefly here. First there is the medium, glass (silica-soda-lime). The *PGM* mention three types of sympathetic material: animal, mineral (with many lithic types) and vegetable (or plant), all appropriate vehicles for the storage and conveyance of spiritual power. But where is glass? There is no discussion of this material, and this is surely a curious omission. Second, there is the process by which a hardstone bezel became the locus of δύναμις/numen.[47] This was called empsychosis/ensoulment, better known in English as consecration. Once ensouled the stone amulet, now the locus of imputed *dynamis*, could be tied onto or around a body part that needed special strength or healing or protection, thus creating a kind of bonded shield against harm, which could be expected to materialize under a bewildering array of assaults. An attack triggered for example by *phthonos/invidia*[48] was among the most dreaded and demanded a powerful amuletic shield of defence. These are interesting details, but can any of them be corroborated based on the empirical investigation of glass pendants? Probably not. Why there is no *PGM* discussion of glass as a suitable substrate for skirmishes against *daimones* is difficult to comprehend, given the long history of Phoenician/Carthaginian westward-bound, water-borne commerce in glass amulets. As for the matter of consecration, given the negligible cost per unit of a glass pendant, it is difficult to envisage a per unit payment to a magician so that he or she might perform a ritual praxis turning these very small lumps of glass into power centres. An ensoulment by lots (perhaps in the 100s or 1000s per lot), is possible, but then buyers might be turned away with lingering fears that *dynamis* had been diluted and compromised.

In his review of Bonner's book, Erwin Goodenough faulted Bonner for his treatment of amulets marked with ambiguous images (which by a long-bred Jungian inclination Goodenough called symbols) and ambiguous names 'for what an amulet means is much more obvious when it has πέπτε on it than when it has simply divine figures and names, with or without magical syllables'.[49] Goodenough remarked that the study of symbolism (i.e. iconography) was 'repellent to the scholarly mind, because in it understanding requires the acceptance of confusion, rather than the creation of clarity'. Goodenough's concept of 'scholarly mind' is the mind trained to read and write, the mind of the linguist, the philologian, the student of literature, in short the mind that Bonner possessed in such conspicuous (and exceptional) degree. Goodenough's complaint (not very clearly stated) was that Bonner had bungled the complexities of pictorial/visual evidence. This is relevant to our concern here, because the glass pendants in the British Museum contain incuse devices that are almost entirely anepigraphic.[50] Otherwise, all incuse fields are marked with iconography alone, either figural or non-figural, minus any and all written prompts. Thus, in confronting our body of glass evidence, are we like Goodenough's Bonner condemned to the 'acceptance of confusion'? Amulet study which began in the 19th century as an anthropological/archaeological inquiry[51] recently has been transformed (especially on the Late Antique specimens) into a linguistic/philological discipline that exhibits hesitation (mixed with diffidence) in confronting iconography. Roy Kotansky put the matter succinctly: '…uninscribed amulets are difficult or impossible to identify; even when they carry some telltale symbol or design, they remain silent about their specific purpose or the source of their efficacy'.[52] This is Goodenough's scholarly mind in spades – only a philologist could love this counsel of despair.

Iconographic markers in the objects catalogued here are actually quite clear and reflect the workings of purposeful

intelligence. The menorah, the cross, the Medusa head are all widely attested amuletic signs in Late Antiquity – on this point there is consensus. In the figures of major 'power brokers' such as Helios, Artemis and Christ, there is *dynamis*, also clear and unmistakable. The heroic presence appears under the images of the mythic twins (Romulus and Remus), of Daniel the intrepid Hebrew prophet, and of the Syrian pillar ascetics, whose agonistic athleticism energized 5th to 6th century imaginations far beyond the borders of the Levant. There is also the guarantor of 'Unheimlichkeit', Isis the weird, uncanny magician, frightening in the power she wielded. And there is the avatar of the impossible, the goddess Nike who invariably managed to wrest victory out of defeat. These are powerful images, carefully chosen, exhibited with intent. We also encounter images of men and women facing one another and joining hands, sealing agreements, sharing intimacies. And of the sheep-carrying shepherd, who in earlier Greek iconographic tradition had been a grim porter of sacrificial victims to the holocaust – in this 4th-century context metamorphosed into a σωτήρ, not obliterating life but saving it and delivering even little people from anonymity. The astrological powers, Aries, Scorpio, Leo and Eros riding a lion[53] are also conspicuously front and centre. In short, sliced one way or the other, downgraded to 'some tell tale symbol' or upgraded to a time-honoured iconographic conceit, the result is the same: not the 'acceptance of confusion' but instead clarity in the depiction of protection, healing and nurture. These are the kinds of image that a buyer might have wanted to have displayed around the neck, to protect against losing his or her head. In fabricating these pendants, unknown 4th- and 5th-century die cutters and glass workers made conscious choices, prompted by a consumer market consisting of buyers admittedly presiding over limited funds but nonetheless charged with identifiable intents and purposes. Furthermore, the wearers of these objects carried them into their graves as we have seen and their use as grave goods underlines their importance as amuletic devices.

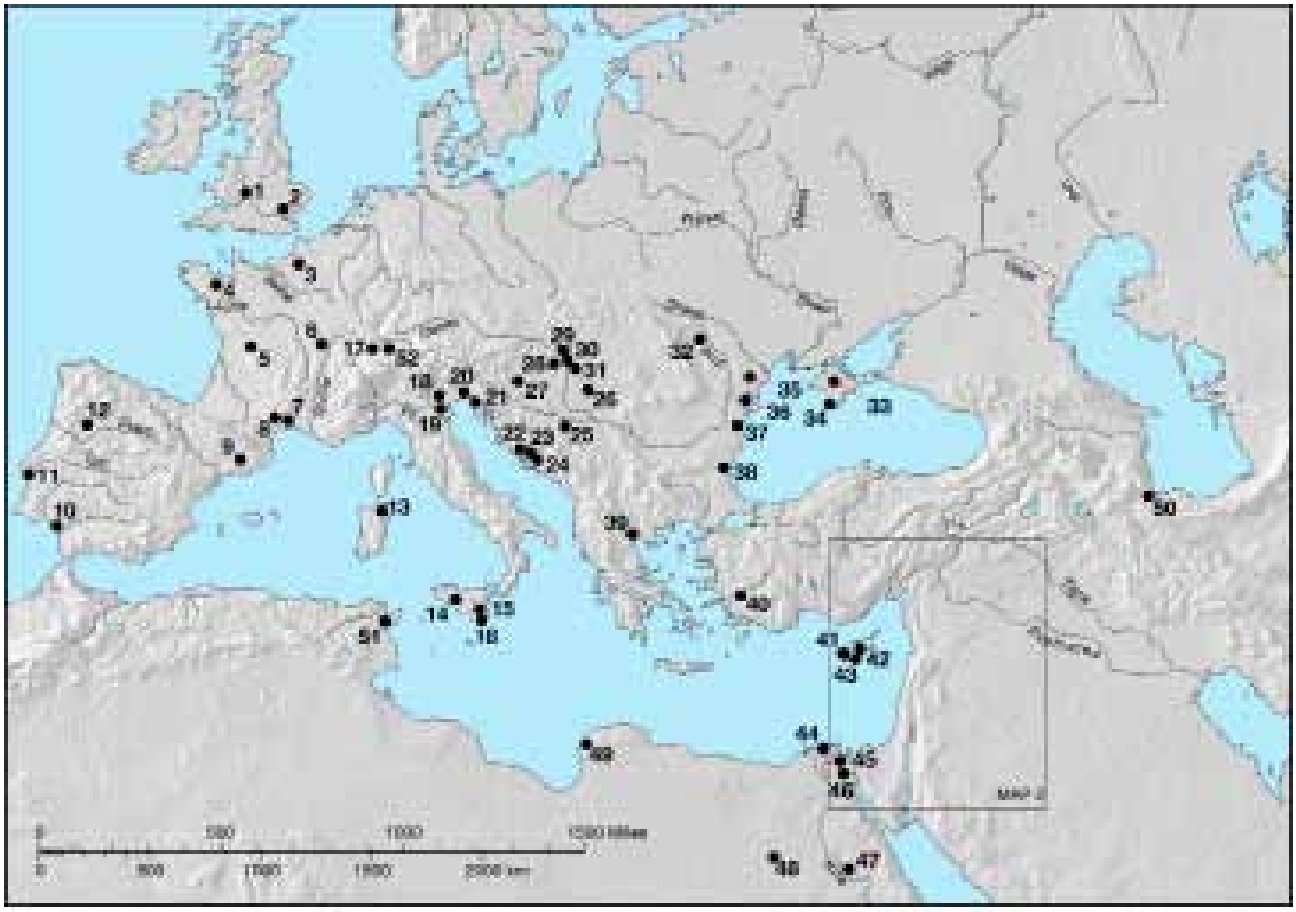
Distribution and origin

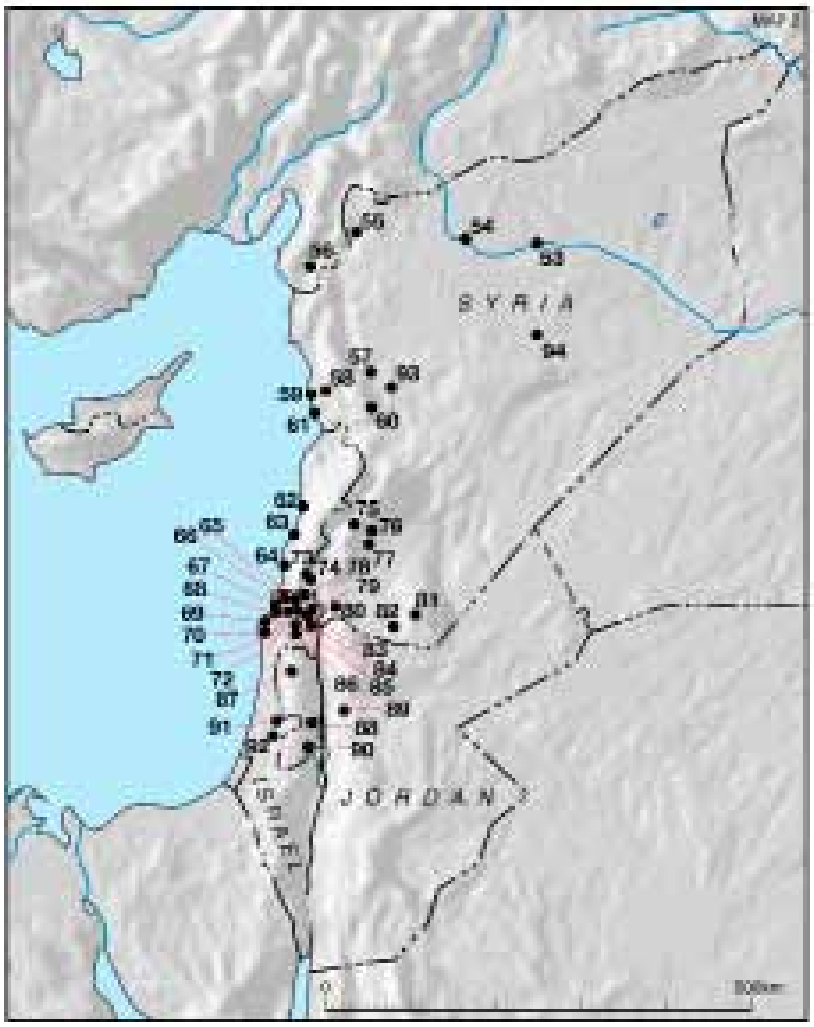
These pendants are found throughout the Mediterranean basin and its hinterlands. Although European finds are concentrated primarily in Italy and the Balkans, a few examples are found in northern, western and eastern Europe. Only two are known from the United Kingdom: an example from Droitwich in Worcestershire, possibly associated with the imperial salt workings there, and one which possibly came from Braughing in Hertfordshire (cat. no. 6). Six examples are known from France ranging from La Chapelle-des-Fougeretz in Brittany and Amiens in Picardy (cat. no. 23) through to Antigny (Vienne) and Autun (Burgundy) in central France and, finally, Lunel-Viel and Saint-André-de-Sangonis in the Languedoc. Finds in the Iberian peninsula are rare and there are only four published examples: two from Spain (Guissona, near Lerida, and Rio Tinto), and two from Portugal (Idanha-a-Velha and Alcochete). In Italy, apart from Sicily, the southern and central parts of the country (including, surprisingly, Rome) are devoid of any finds. On the contrary it is in the north-east of Italy where nearly half of the pendants found outside the Levant are located: 17 examples in Aquileia and 13 in Trieste. Further concentrations are found in Split and its environs in Croatia (at least 18 examples), and in Hungary, particularly around Lake Balaton. Other isolated finds extend eastwards into modern day Bulgaria, Romania, the Ukraine and the Crimea. Finds in the southern Mediterranean, Greece, Turkey and North Africa are comparatively rare.

Of the over 220 examples with known proveniences the greatest concentration of finds is in the Levant with 53 examples from Syria, at least 40 from Israel, 17 from Lebanon, and 14 from northern Egypt. The majority (52 examples) are found in a swathe from northern Galilee to Lake Tiberias and its environs and through to the Hauran. Few have been found in sites in central Israel with the exceptions of Samaria/Sebaste (one), Jerusalem (one) and four near Hebron in Judaea. (This distribution probably militates against Jerusalem as the source for these pendants.) A smaller group (nine examples) are clustered around Homs and Hama in western Syria. There is no evidence to link particular iconographic types to certain areas. An unpublished distribution map of those pendants stamped with lions – by far the most numerous type – shows that they are found all over Europe and the Middle East. The finds from Split, for instance, include both figural and non-figural types, both Christian, pagan and Jewish scenes and motifs.

As their distribution suggests the majority, if not all, of these pendants, were probably made in the Syria/Palestine region, an attribution which is supported by the few scientific analyses which have been undertaken. The following paper in this volume by Stefan Röhrs and Andrew Meek reproduces the results from analyses of 38 of the British Museum's pendants conducted in 2008 and 2012 by the Museum's Department of Scientific Research. This report concludes that the majority of the specimens analyzed belong to the groups known as 'coloured Roman', HIMT and Levantine I: these three groups are typically a composition of soda-silica-lime, with natron the flux employed to produce the glass, and Levantine I in particular is associated with glassworking centres at Jalame, Dor, Bet' Shean and Apollonia.[54] The silica-lime sand originated from the mouth of the river Belus, near modern Akko between Haifa and Acre. Recent analytical and archaeological research suggests that raw glass production was a discrete process from that of vessel manufacturing. The former process was carried out in production centres located near the source of the raw materials and combustibles; the latter – the production of a wide range of glass wares – took place in workshops located in the industrial and commercial centres of the Levantine cities. After firing and melting the raw materials, the furnaces would have to be dismantled to extract the cooled raw glass; this was then broken up into chunks and distributed not only throughout the Middle Eastern region, but to European centres as well.

The widespread distribution of glass with compositional characteristics typical of Roman Levantine glass (e.g. Levantine I and HIMT) is attested by analyzed finds from European find spots exemplified for instance by cat. no. 6, the pendant from Braughing, Hertfordshire (HIMT). This raises the question as to whether local workshops based in




SYRIA
JORDAN
ISRAEL

Findspots/key to maps:

1. Droitwich, Worcestershire, England (1); 2. Braughing, Hertfordshire, England (1); 3. Amiens, France (1); 4. La Chapelle-des-Fougeretz, France (1); 5. Antigny, France (1); 6. Autun, France (1); 7. Lunel-Viel, France (1); 8. Saint André de Sangonis, France (1); 9. Guissona, Spain (1); 10. Huelva, Spain (1); 11. Porto dos Cacos, Alcochete, Portugal (1); 12. Idanha-a-Velha, Portugal (1); 13. Olbia, Sardinia (1); 14. Sicily (4); 15. Piazza Armerina, Sicily (1); 16. Acrae, Sicily (1); 17. Augst, Switzerland (1); 18. Bolzano-Gries, Italy (1); 19. Salorno, Italy (1); 20. Aquileia, Italy (17); 21. Trieste, Italy (13); 22. Kaštel Sućurac, Croatia (1); 23. Solin, Croatia (17); 24. Split, Croatia (unknown); 25. Dalmatia (2); 26. Štrbinci (Roman Certissia ?), Croatia (1); 27. Poetovio, Slovenia (1); 28. Keszthely-Dobogó, Hungary (2); 29. Baláca, Hungary (1); 30. Ságvár, Hungary (1); 31. Czikó, Hungary (1); 32. Mihălăşeni, Romania (3); 33. Crimea (unknown); 34. Chersonesos, Ukraine (1); 35. Nagornoe, Ukraine (1); 36. Tulcea, Romania (1); 37. Callatis, Romania (2); 38. Burgas, Bulgaria (1); 39. Thessaloniki, Greece (2); 40. Sardis, Turkey (1); 41. Cyprus (6); 42. Idalium, Cyprus (3); 43. Amanthus, Cyprus (1); 44. Alexandria, Egypt (1); 45. Defenneh, Egypt (2); 46. Gheyta, Egypt (1); 47. Akhmim Panopolis, Egypt (1); 48. Egypt (9); 49. Sidi Khrebish, Benghazi, Libya (1); 50. Gilan province, Iran (4); 51. Carthage, Tunisia (1); 52. Görbelhof (Rheinfelden), Switzerland (1); 53. Ar-Raqqah, Syria (1); 54. Emar, Syria (1); 55. Qal'at Seman, Syria (1); 56. Antioch, Turkey (2); 57. Hama, Syria (2); 58. Kefr Ra, Syria (3); 59. Tortosa, Syria (1); 60. Homs, Syria (2); 61. Amrit, Syria (1); 62. Beirut, Lebanon (8); 63. Sidon, Lebanon (1); 64. Tyre, Lebanon (8); 65. Tarshihā, Israel (8); 66. Khirbet el-Shubeika, Israel (1); 67. Nahariyya, Israel (unknown); 68. Lohamei HaGeta'ot, Israel (2); 69. Tel Shiqmona, Israel (2); 70. Kastra, Israel (2); 71. Karmiel, Israel (1); 72. Sajur, Israel (1); 73. Tel Dan, Israel (1); 74. Horshat Tal, Israel (unknown); 75. Kefr ez Zeit, Syria; 78. Gush Halav (unknown), Israel; 79. Capernaum, Israel (1); 80. Khisfin, Syria (1); 83. Migdal, Israel (3); 84. Tiberias, Israel (1); 85. Nazareth, Israel (3); 86. Migdal Ha Emeq, Israel (1); 87. Samaria/Sebaste, Israel (1); 88. Mount of Olives, Jerusalem, Israel (3); 89. Amman, Jordan (2); 90. En-Gedi, Israel (1); 91. Beit Gemal, Israel (1); 92. Bêt Jibrûn, Israel; 93. Selemiya, Syria (1); 94. Syria (7)

Plate 7 Glass 'trilobitenperlen' with a Medusa head, Hungary (?), 4th century. British Museum, London (PE 1980,0611.77)

mainland Europe might have been manufacturing these pendants using imported glass, in particular in those areas where there are unusual concentrations found within the overall distribution pattern as, for instance, at Solin, near Split, in Croatia, Aquileia and Trieste in northern Italy and around Lake Balaton in Hungary. Here it is possibly instructive to compare the pendants with a related group of glass jewellery known as 'trilobitenperlen', which were referred to briefly in the introduction to this paper.

This group was first discussed in detail by Thea Haeverninck in 1973. Made mainly from black opaque glass, these objects take the form of double-channelled beads with either figurative (**Pl.** 7) or non-figurative decoration; it is only the former category which concerns us here.[55] With the exception of one type, the known figurative examples find almost exact iconographic parallels within the pendant corpus: these include those with frontal female busts and the inscription NIKE (*cf.* cat. nos 15–16),[56] confronted male and female busts (*cf.* cat nos 17–20),[57] profile female busts (*cf.* cat. no. 22), Medusa heads (*cf.* cat. nos 41–3), an actor's mask (*cf.* cat. no. 77), and a frog with the inscription ZOHN (*cf.* cat. nos 78–9). Although found over much of Europe,[58] there are particular concentrations of these spacer beads in Aquileia, Salona and throughout much of modern day Hungary, precisely the areas noted above in which a number of the glass pendants have been located. It has been suggested that Aquileia and Salona, both of which were centres for gem production in the 3rd century, were the production and distribution centres for these spacer beads. Do the iconographic affinities between the two groups of material hint at local workshop production for both pendants and beads? Or do they reflect only local production for the beads based on the adaptation of a limited number of the pendants from an iconographic perspective? If so what motivated these specific selections? These questions are unlikely to be answered until technical analyses have been done on a statistically significant amount of both types of object to determine the type of glass employed. Until then it seems reasonable to suggest secondary local production of the pendants based on the export of Levantine-type glass to ports such as Aquileia and Spalato (and perhaps even the dies too).[59]

Chronology

These pendants have traditionally been dated to the 4th or early 5th century and this is largely supported by those finds

Plate 8 Silver saeculares of Philip I (AD 244–9) with a lion with striated mane. British Museum, London (CM R0520)

Plate 9 Antonianus of Caracalla (AD 198–217) with a lion with solar mane. British Museum, London (RIC 273c)

which come from excavated contexts. The most important of these are briefly reviewed below. The evidence for earlier pendants is largely dependent on a small number of 3rd-century coin parallels. Two are particularly worthy of mention. The first is a *saeculares* of Philip I (AD 244–9) in the British Museum, which has a lion with striated mane going to right (**Pl. 8**).[60] These striations are either a cruder rendering or misunderstanding of the radiate crowns found on lions which decorate the earlier coinage of the Emperor Caracalla (AD 198–217) (**Pl. 9**).[61] Those pendants with lions with striated manes (*cf.* cat. nos 44–9, 58) may well be copying these earlier coin types. Another striking coin parallel can be found for cat. no. 23, which depicts two standing figures holding hands, in radiates of Aurelian dated to AD 271–5 (**Pl. 10**).[62] It is conceivable, however, that these coins were still in circulation in the early 4th century and that it was then that they were copied.

European finds

1. Amiens, France[63]

A lead coffin, discovered in the 1840s, contained two skeletons, one male, one female. Associated with the latter were a pair of gold earrings, a pair of gold bracelets, a gold *fibula*, three fragments of glass unguentaria, a glass pendant (cat. no. 22) threaded on an earring, and finally a gold ring with a classical gem set into a ring of Merovingian type.

2. Verdier, Lunel-Viel (Hérault), France[64]

Tomb 40 in a cemetery there of 330 burials had an adult

Plate 10 Reverse of copper alloy coin with Aurelian holding the hand of Concordia, Siscia, AD 270–5. British Museum, London (CM 1962,1212.275)

burial with four pots, various beads and a pendant with two standing figures (*Cf.* cat. no. 23). The pottery types, the type of tomb and its location in the cemetery dates the pendant to the first half of the 4th century.

3. Thessaloniki, Greece[65]

An amber pendant with a lion, crescent and star was found during the removal of bones next to grave 65 in the Eastern Cemetery. It was found together with a bronze coin of Constantine (minted AD 320), seven glass beads, part of an iron nail and a piece of bronze wire.

4. Keszthely-Dobogó, Hungary[66]

Excavations in 1955 revealed a Late Roman cemetery. Grave 56 of this cemetery contained a skeleton and two pendants, one stamped with a lion to right, the other with a frog and ZOH. The grave also contained a small bronze coin of Crispus and Constantius II.

5. Ságvár, Hungary[67]

Grave 340 of the cemetery contained a child's burial with, *inter alia*, an earthenware jug, a bronze bracelet with snake-head terminal, two bronze rings, an amber bead, nine glass beads and one glass pendant with a horse to right (*cf.* cat. no. 84). The 147 coins found in the associated graves range in date from Constans to Valentinian, the latest coin of the latter emperor datable to AD 375.

6. Mihălăşeni, Romania[68]

Bewteen 1982 and 1988 a large cemetery of the Sântana-de-Mures culture was excavated at Mihălăşeni in Botosani province. The cemetery was composed of 91 tombs with incinerations and 426 with inhumations, the latter belonging to phase C3 to D1 around AD 320–390/95. In tomb no. 123 of the cemetery there was a slightly disturbed female burial, oriented north–south, with the head at the north. Grave goods included a silver *fibula* and a necklace composed of 22 glass beads with three pendants decorated with a female bust, a frog, and Daniel between the lions. The grave was dated to the third quarter of the 4th century by the excavators.

7. Nagornoe, Ukraine[69]

A glass pendant with an orant figure (*cf.* cat. no. 34) was

found as part of a necklace in grave 74 in a cemetery at Nagornoe II near Lake Kagul. The cemetery included 95 inhumation and cremation graves of the Sântana de Mureş-Černyakhov culture. Grave 74, one of a small group of graves within the cemetery to be oriented west–east, contained the inhumation of a child aged between 6 and 8. Additional grave goods included four beads and a pale green glass beaker, but no pottery. The grave is dated to the second half of the 4th century.

Middle Eastern finds

1. Tyre, Lebanon

Between 1959 and 1967 an extensive Roman and Byzantine cemetery was excavated on the outskirts of Tyre which yielded finds of pendants from:

'Massif' 730-731/loculus no. 3 contained a silver earring, a pendant stamped with a lion with striated mane leaping to left, and four bronze coins only one which could be read and dated to the 4th century. Two nearby loculi contained coins as late as Honorius (AD 395–423).[70]

'Massif' 3914-3918/loculus no. 3 contained a pendant with an indistinct motif together with earrings and coins ranging in date from Elagabalus to Arcadius (AD 395–408).[71]

'Massif' 4177/loculus 2 contained two pendants, one with a quadruped, together with gold earrings, beads, pins and bracelets and bronze coins, the latest being of Constantius II (AD 341–6).[72]

Sarcophagus 668-669 contained two pendants, one with a human face, the other with a lion to right, found with gold earrings, glass beads and a coin of Claudius Albinus.[73]

Sarcophagus 2723-2724 contained beads and bracelets plus two pendants only of which has a recognizable design of a lion with striated mane walking to left with star and crescent above.[74]

2. Tarshihā, Israel[75]

Situated in northern Israel some 20km east of Nahariya on the coast this site comprised a rock-cut tomb consisting of a vestibule and four loculi which was excavated in 1931. From the vestibule came one amber pendant stamped with a lion and a star and crescent above, and from loculus 1, five similar pendants and two others, one stamped with a tortoise, the other a menorah. Seventy-eight coins came from the tomb, the latest decipherable one being of the Emperor Arcadius (AD 395–408).

3. Kibbutz Lohamei HaGetat'ot, Israel[76]

Salvage excavations uncovered a burial ground opposite the eastern slope of Tell es-Sumeiriya covering approximately 250 square metres with Persian, Hellenistic and Roman burials. Burial B consisted of a stone cist which contained, *inter alia*, two glass bowls, four glass bottles, a beaker, five miniature glass bottles, two blue glass pendants with lions and six glass beads. The pendants are dated to the first half of the 4th century not only by the associated glassware which finds numerous parallels in Israel, but also by five bronze coins ranging from the reigns of Hadrian to Licinius, Helena and Constantine II (AD 337–40).

4. Karmiel, Israel[77]

The excavation consisted of a quarry and three burial caves. Cave 3 contained two clay sarcophagi, one of which contained a pair of gold earrings, a glass pendant stamped with a lion with a star and crescent and five beads. There were also ten bronze coins of Diocletian (1), Licinius (2) and Constantine I (7).

5. Migdal Ha-'Emeq, Israel[78]

The site of Migdal Ha-'Emeq is a few miles south-west of Nazareth. In 1990–1 a cemetery composed of 16 Hellenistic, Roman, Byzantine and Persian tombs was excavated. Two of the tombs, M and P, yielded glass pendants. Tomb M had a square courtyard that led to a multiple burial complex with *kokhim* cut into the walls. The pendant, which depicts a man milking a goat, was found together with ceramic jugs, flasks and lamps.

6. Migdal, Israel[79]

Migdal is situated just to the north of Tiberias on the sea of Galilee. In early 2002 two excavation areas were opened. In stratum III of Area C a number of walls of basalt and limestone blocks were uncovered. Finds included a glass pendant with a lion to right, and Kefar Hananya-type vessels, including Galilean bowls, cooking pots, jugs and Sihin vessels. The latest pottery dated to the middle of the 4th century.

7. Tiberias, Israel[80]

A pendant stamped with a frog (*cf.* cat. nos 78–9) was found during the 2004 excavations of a basilical complex in the centre of ancient Tiberias. The central area of the building included a narthex, a courtyard and a reception hall in whose foundations the pendant was discovered. The latest coins found in the foundations of the complex date to the 4th century as does the associated pottery and glass.

8. Emar, Syria[81]

The site of Emar by Lake Assad in northern Syria was excavated between 1996 and 2002. In the so-called Temple Area a cemetery of over 125 graves was uncovered. Grave 63/51-G07 was a rectangular grave pit with the partly disturbed burial of a child. Along with two glass bracelets positioned at either wrist was found a necklace of glass beads in different shapes and colours with a central glass pendant stamped with either Minerva or Roma. An adjacent grave (66/53-G02) yielded a copper coin dating to the reign of Constantine II (AD 337–40) and probably minted at Antioch.

Parallels in other materials

Gemstones

While there are parallels between glass pendants and gemstone bezels, there are also differences, of which the most obvious is format: circular in the case of the pendants, oval in the case of gemstones (with devices displayed along either transverse or vertical axes and inscriptions sometimes arranged in an annular or elliptical trajectory that hugs the rim). There is also another distinction: glass pendant devices set within incuse fields are second-generation (cameo)

impressions generated from intaglio-cut iron die prototypes, now lost; by contrast, the intaglio-cut miniatures on hardstone bezels are themselves first-generation prototypes of which ancient impressions do not survive. While these differences are significant, they do not erase the basic premise: the two 4th-century distinct material types, glass pendants and engraved lithic bezels, share commonalities.

Three attributes underscore those commonalities: size, fabrication and device(s). On size, the diameters of incuse glass fields on pendants register on average in the 13/16mm. range, dimensions that are paralleled in multiple surviving engraved gemstone bezels dateable from the 2nd to 6th century. The original metal dies used to stamp glass pendants do not survive, but their dimensions must have corresponded rather closely (within ¼ to ½mm) to the diameters of surviving incuse glass fields. In other words, cutters fabricating metal dies for use in the production of glass pendants and gemstone cutters working with hardstone bezels faced the same challenges of scale: how to fit an engraved image (or images) onto a hard miniature field, less than 20mm. in diameter.

On the second issue, fabrication, die cutters working with iron and gemstone *scalptores*, *cavatores* and *insignatores*[82] labouring on hardstone encountered substrates that shared communalities not just of size but also of hardness. These were unforgiving materials, hardstone more than iron. The latter registers in the 4.0/5.0 range of the Mohs scale. The lithics that were most popular in the Late Antique gemstone industry, for example the quartzes and the garnets, register in the 6.0/7.5 range. Engraving of the latter clearly poses the greater challenge. Iron dressed with a mallet and burin was the more malleable substrate, although in the examples of amazonite, haematite, onyx and pyrite, not by a wide margin. The skill set and tool box required for cutting miniature iron dies must have been very close (if not identical) to what was required for gemstone engraving.

The issue of quality also falls under the fabrication rubric. There is little scholarly disagreement on this subject: compared to devices cut into hardstone bezels, the images that appear within the incuse fields of glass pendants generally reflect inferior τέχνη. All along the production network, cost is the decisive factor, from the gathering of raw material, the cost of building and maintaining a working foundry and identifying accessible fuel sources, the cost of tools (including dies), the cost of labour the cost of distribution, and the cost of percentages let to vendors. Owners will have realized a return on capital based on volume, not on an individual sale or two. Margins per unit will have been low, and ongoing manufacture will not have been sustainable without sales of many hundreds of pieces. Foundries will have purchased or leased die sets, and the cutters who supplied this essential cog in the manufacturing process very likely will have been τεχνίται at the lower end of the die-cutting food chain. Similarly the glass workers (*vitrearii*) who broke up the blocks of raw material into smaller aggregates and refired it and fabricated the pendants out of small blobs (1.0/2.0g on average) of vitreous gather will have laboured under time pressures and will have produced many units reflecting sloppy workmanship. Compensation for glass workers producing pendants is unknown, but it cannot have been much. All of this stands in contrast to the gemstone industry where the raw material was obtained at a high cost, where labour was highly skilled (no doubt well compensated in at least some workshops) and quality of workmanship counted for a great deal, and where owners of *officinae* might expect a substantial return on capital based even on the sale to high-status clients of only one or two finely engraved gemstones.

In assessing parallels between our two material types, glass pendants and engraved gemstones, the third and last factor concerns devices. Exact correspondences are rare, but even in the limited number of examples catalogued here, very close parallels are numerous. Among figural subjects such parallels are reflected in the following types: Romulus and Remus, Eros, opposing profile busts, *dextrarum iunctio*, the shepherd-kriophoros, and Medusa heads. Among non-figural (faunal) subjects: lions walking or pouncing, lions attacking victims, lion protomes, frog, tortoise, scorpion, caprid, ram; and among non-figural inanimate objects: menorah, *iota/chi* and equilateral cross. It is highly probable that the fabricators who produced dies for glass pendant manufacture modelled their iconographic inventories on gemstone prototypes. Since we know next to nothing about the internal structures that operated within glass and gemstone *officinae*, we cannot determine how die cutters obtained their device-related materials, whether from model books that circulated within individual workshops, or perhaps from collections of stones that workshop foremen[83] held aside as a permanent inventory to be used as prototypes.

Conclusion

The objects catalogued here constitute a small (but arguably important) sampling of a glass type ignored by earlier generations. This is only one among many such collections worldwide. The British Museum glass pendants afford just a glimpse at a large subject – how large is impossible to gauge (a database is much needed). Nay sayers (especially glass and gemstone aficionados) are likely to demur, or as one colleague eloquently put it, these certainly are 'ugly little buggers', the mere crumbs that had fallen off the tables of Victorian gentlemen collectors, somehow and for some unknown reason preserved and swept up off their floors. Who the British collectors of these objects were and why they collected pieces of this (relatively inferior) quality are indeed interesting questions that deserve answers, but not here. In the end, comparisons (based on the quality of τέχνη) between high-end glass (or gemstones) and the objects catalogued here are a diversion. Such comparisons neither ask nor answer questions of importance to scholarship. What glass pendants do provide is information (based on documented archaeological evidence) concerning manufacture, distribution, date and the socio-economics of patronage. This is information that is almost entirely wanting, for example, in the study of putative 4th-century engraved gemstones. The long and the short of it is that there is something to be gained from the study of these objects, whether judged as 'ugly little buggers' or bonny bibelots.

The emergence of these glass pendants as the predominant mass-produced amulet in the 4th century in

the Levant has to be understood in the context of various social, economic and religious changes. Despite the recognition and promotion of Christianity as a major religion by Constantine the Great, and the continuing hostility to pagan cults from the imperial and religious authorites which culminated in Theodosios' edict of AD 392 prohibiting sacrifices and other cult practices, paganism seemingly continued to flourish throughout much of the 4th century. Indeed the continuing belief by Christian, pagans and Jews alike in the all-pervasive malign influence of the Evil Eye remained unabated and necessitated the widespread need for amuletic devices. Belief in the potency of *baskania/invidia* did not simply disappear overnight with the onset of Christianity: lead amulets, for instance, employing the Medusa head as an apotropaic device were still being produced in the Middle Byzantine period.[84] The glass pendants discussed in this paper occupy a distinct place in the history of Late Antique amulets, even though their role as personal adorments must also be acknowledged. Despite the fact that the exact meanings of many of the images employed on the pendants remain elusive, there is an argument that with the disappearance of gemstones which had been the dominant material in which amulets had been fashioned for well over 200 years, glass occupied pride of place as the preferred medium of choice for amulets in the Levantine world for perhaps a 100 years or more. The reasons for their decline in the 5th century and their eventual replacement by metal amulets remains as yet unexplained.[85] It may well have had to do with changes in the glass industry in the Syro/Palestinian area or a change in fashion. Many aspects of these pendants still remain unexplained and require future research.

Catalogue

1. Glass pendant
4th century
h. 24.8mm; w. 18mm; max d. of incuse 14mm; wt 1.3g
Colour: L*a*b*45 9 31; Munsell 10YR 4/4
Reg. no. PE 1983,1108.49

Translucent amber disc with rolled rim and suspension loop.A she-wolf standing to left with backward-turned head looking at the diminutive opposed figures of Romulus and Remus with both their hands raised to her belly.
Cf. Henig 1975, no. App. 77 (from Droitwich, Worcestershire); Price 1977, 31, no. 5 (from Huelva, Spain); Zouhdi 1978, no. Ia, 54, fig. 3a (from Homs, Syria); Lopez de la Orden n.d., no. 160, 159, pl. 15.
Gems: *AGDS* 1.3 no. 2338; *AGDS* 2 no. 532; *AGDS* 3 (Kassel) no. 79; Fossing 1929, nos 919–21.
Coins: Carson 1980b, nos 1253, 24 (aureus of Maxentius, AD 308) and 1320, 38 (follis, AD 330).

Iconography: Romulus (an eponym of Rome) and Remus were the primary symbols of the Augustan foundation myth (or legend), claiming for Rome a divine origin.[86] Mars raped Rea Silvia who gave birth to the twin boys; the two were exposed in a reed basket floating on the Tiber, suckled by the she-wolf, Lupa Romana,[87] and raised by the royal herdsman, Faustulus and his wife, Acca Larentia. Romulus and Remus were credited as founders of the original nuclear settlement on the Palatine Hill.

The iconography on this and the following pendant repeats the formulaic image of Lupa Romana standing and facing left, her head turned back to the right toward the two boys who stand, kneel or sit beneath her pendulous teats.[88] In the Constantinian period, the twin boys were assimilated to the Dioscuri (= Gemini). The second of the pendants (cat. no. 2) shows a star and crescent in the field above the back of the she-wolf, thus making explicit the reference to astrology.During the Roman Imperial period, Romulus iconography appeared with some frequency in funerary contexts, alongside images of an eagle, of Aion, or of a ram (= Aries), suggesting assimilation of deceased humans to heavenly bodies in the afterlife.[89] But in a Late Antique Levantine context such as the one envisaged here, the she-wolf and the two suckling boys had become iconic markers of Roman cultural and political identity. (PCF)

Unpublished.

2. Glass pendant
4th century
Provenience: Egypt.
Max d. 19mm; max d. of incuse approx. 14mm; wt 1.4g
Colour: L*a*b*35 9 14; Munsell 8YR 4/3
Given by the executors of Felix Slade in 1873.
Reg. no. GR 1873,0502.130

Translucent amber disc with rolled rim; suspension loop missing. A she-wolf standing to right with backward-turned head looking at the diminutive opposed figures of Romulus and Remus beneath her belly; in the field above, a star and crescent moon.
Cf. De Ridder 1909, no. 676; Cambi 1974, no. br.II 7, 143 and 149 (from Solin, near Split); Barag 2001, no. 360, 179, pl. 29; Barag 2002, no. LA-10, 312.
Gems: *AGWien* III no. 1641.
Coins: Carson 1980a, no. 1026, 136 (antonianus of Probus, AD 277); Carson 1980b, no. 1293, 33 (bronze medallion, Rome, AD 330–7), but with two stars in the field; no. 1320, 38 (follis, Nicomedia, AD 330), but the wolf to left.

Unpublished.

3. Glass pendant
4th century
h. 21.2mm; w. 18mm; max d. of incuse 12mm; wt 1.5g
Colour: L*a*b*33 -9 -4; Munsell 2B 3/3
Reg. no. PE 1983,1108.52

Translucent blue disc with rolled rim and suspension loop. In a quadriga – a chariot drawn by four horses – the diminutive standing figure of Helios/Sol, arms raised, holding a flail in his left hand.
Cf. Orsi 1912, 209, fig. 4c (from Sicily); Eisen and Kouchakji 1927, 527, pl. 131; Sale catalogue 1978, no. 2; Sale catalogue 1989, no. 278, 76–7; Barag 2001, no. 359, 179, pl. 29; Barag 2002, nos LA-12 – LA-15, 312–14; Whitehouse 2003, no. 957; Mandruzzato 2008, no. 136, 76 (from Aquileia). There is also an unpublished example in the C.S. collection in Munich (no. 1187).
Gems: Fossing 1929, no. 903; Bonner 1950,

nos 174 and 227; Schauenberg 1953, 81; *AGDS* 1.3 no. 2645; *AGDS* 3 (Kassel) no. 157a; *AGDS* 4 (Hamburg) no. 81; Exhibition catalogue 1983, no. 115, 508. For the image on magical gems see: Delatte and Derchain 1964, nos 295–6; Michel 2004, pl. 53:1, 423; Chiesa 2012, no. 94, 219.
Coins: Carson 1980a, no. 1031, 137 (antonianus of Probus, AD 280); Carson 1980b, no. 1234 (silver coin, Trier, AD 312–13);

Iconography: The iconographic template of this pendant and its two parallels (cat. nos 4 and 5) is the myth of the Greek sun god, Helios, son of the Titans, Hyperion and Theia. The Hellenic prototype is important because it renders the sun god in a figural (or anthropomorphic) guise. Numerous ancient Near Eastern sun gods were venerated in Late Antiquity, but many were imaged as non-figural types. Helios' story centres on his daily rounds. He rose before dawn in eastern Okeanos, ascended from his watery habitat in his quadriga to the summit of the heavens, during the second half of his day he descended to the western edge of Okeanos. In the darkness of the night hours, he returned, water borne, to his eastern point of origin in preparation for the start of the new day.

Cat. nos 3–5 show Helios en route – whether ascending or descending cannot be determined. In Late Antiquity Helios was imaged as an heroic nude, his only article of clothing being a mantle or cape (chlamys or *paludamentum*) fastened round his neck and flowing free in the wind, but this detail is wanting in the three examples presented here. Typically he was shown with a flail in one hand, a sign of dominance – all three of the chariot pendants include the flail. Cat. no. 5 also exhibits the god's solar diadem with its projecting (usually gold) upright spikes that mimic the sun's bright rays.[90] The diadem was the quintessential marker of heliac identity. (PCF)

Unpublished.

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4. Glass pendant
4th century
Provenience: probably Egypt, perhaps Akhmim Panopolis.
Max d. 17.5mm; max d. of incuse 12mm; wt 1.1g
Colour: L*a*b*40 5 10; Munsell 9YR 4/3
Bought from the Rev. G.J. Chester in 1891.
Reg. no. GR 1891,0613.26

Translucent amber disc with rolled rim; suspension loop missing; cracked and repaired, with the centre wanting. In a quadriga, the diminutive standing figure of Helios/Sol, arms raised, holding a flail in his left hand.
Cf. cat. no. 3.

Unpublished.

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5. Glass pendant
4th century
Max d. 20.2mm; max d. of incuse 15.5mm; wt 1.4g
Colour: L*a*b*45 8 29; Munsell 2Y 4/4
Reg. no. PE 1983,1108.53

Translucent light amber disc with rolled rim; suspension loop and top left-hand corner missing. In a quadriga, the diminutive standing figure of Helios/Sol wearing a diadem set with three projecting spikes and holding a flail in his right hand.
Cf. cat. no. 3.

Unpublished.

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6. Glass pendant
4th century
Provenience: Braughing, Hertfordshire, England.
Max. d. 20mm; max. d. of incuse 16.5mm; wt 1.4g
Colour: L*a*b*43 11 29; Munsell 10YR 4/5
Bought from Alberto di Castro in 2007.
Reg. no. PE 2007,8045.224

Translucent amber disc with rolled rim; suspension loop missing. Two opposing profile busts: at left a male bust facing right wearing a diadem with projecting spikes; at right a female bust facing left wearing a headpiece fitted with upturned *lunula*. Helios/Selene and Selene/Luna.
Cf. Eisen and Kouchakji 1927, pl. 131; Whitehouse 2003, no. 956, 42, which probably comes from the same die.
Gems: Fossing 1929, no. 1707; Bonner 1950, no. 192; *AGDS* 4 (Hannover) no. 1709; *AGWien* II no. 1214.

Iconography: The Braughing pendant is a recent and remarkable acquisition discovered in an antiquarian setting. The pendant comes from a pine box with three trays containing 262 items, mainly of Romano-British antiquities. The pendant, glued to the centre of Tray 1, is annotated 'Ad fines'. This is a fictional provenience deriving from the itineraries of the spurious *de Situ Britanniaea* of Richard of Cirencester. It is probable that the finds in the trays marked 'Ad fines' come from the Roman site of Braughing. The pendant does not belong to the narrative cycle of Helios' daily rounds. Instead it is a non-narrative pictorial gloss that highlights the relationship between the sun god Helios and his sister/lover, the beautiful moon goddess Selene 'euplokamis': she of the goodly tresses (not shown here – instead her hair is drawn up in a small bun positioned at the nape of her neck). Selene's head ornament is an upturned *lunula* (miniature crescent) located forward the crown of her head.[91]

The Braughing pendant exemplifies a compositional format (opposing profile busts) that was popular in Late Antiquity, especially on movables, such as coins, metal and stone bezels, and gold-glass roundels. Five examples of this format exhibited on pressed glass pendants appear below at cat. nos 17–21. In a Late Antique context, this format was often pressed into the service of ὁμόνια (concord, friendship, unity of purpose) a virtue that might have been expected amongst partners like Helios and Selene working together toward a common goal. She (together with her sister Eos [dawn]) complemented Helios in the performance of his daily rounds. Eos preceded and accompanied him on his journey of ascent. And after he had descended into the watery western reaches of Okeanos, Selene grasped her chariot reins (a biga instead of a quadriga: signifying her subordination to Helios), and she continued the journey of light (in her case reflected light) into the darkness of the night sky. The Braughing pendant is a non-narrative, miniature icon that invites contemplation of a heavenly syzygy, the conjunction and opposition of two cosmic bodies.

It is difficult to pinpoint a single intentional symbolic meaning that 4th-century viewers would have attached to this pendant. Probably an attributed meaning of this narrow sort never existed. As with all the pendants catalogued here, meaning is largely in the eye of the beholder. But at the same time, for the Braughing pendant an impressive accumulation of associated evidence prompts more than just idle speculation. Late Antiquity was a period in which veneration of sun gods was ubiquitous, inside the borders of the Roman Empire as well as outside. The turbulence of the 3rd century had a catalytic effect – solar sentiment reached an apogee during the years that stretched from the death of Marcus Aurelius in AD 180 to Constantine's assumption of sole rule in AD 324. On this issue the evidentiary markers (epigraphy, numismatics, material magica, astrology, neo-Platonism and the full range of material culture from large sanctuaries and their impressive buildings to miniature objects in glass, metal, stone) all yield an unambiguous affirmation of solar veneration. For a half-century (AD 270 to 324) solar henotheism was the de facto ideology and cult of the Roman state – coin legends, literary sources and inscriptions make this fact perfectly clear.[92] The epithet 'invictus' (unconquered,

and by metonymy, unconquerable) had been appended to Latin Sol a century earlier (first attested epigraphically in AD 158)[93] and by AD 270, the year of Aurelian's accession the Unconquered Sun had become a *diis electus*, *conservator Augusti* and *dominus imperii Romani*. In short, the well-being of the state now depended on Sol invictus, the Unconquered Sun who had become the emperor's constant companion and protector. The image of the Sol invictus together with that of Luna appear within a roundel on the east face of the Arch of Constantine,[94] and on the Sol-Comes coinage Sol invictus appears alongside Constantine as his faithful companion.[95] The Unconquered Sun was thought to provide stability. He and Luna were reliable partners giving light, day and night, year in and year out. In a time of trouble, emperors, generals and high-status bureaucrats responsible for commonweal evidently found reassurance in mementos of a cosmic syzygy that enshrined light and its multifarious benefits. And there may well have been a trickle-down effect. Persons who found themselves in life's more humble stations (such as the men and women who patronized the manufacture and distribution of the objects catalogued here) may have burnished their hope and fortified their will to endure with the same very same signs. Solar sentiments in this form might help explain contemporaneous 4th-century meanings attributed to the Braughing pendant and its cognates. (PCF)

Published: Hobbs *et al*. 2011, 288, fig. 5.

7. Glass pendant

4th century
Provenience: Gheyta, Egypt.
h. 22.2mm; w. 17.2mm; max d. of incuse approx. 15mm; wt 1.3g
Colour: L*a*b*39 10 18; Munsell 7YR 4/4
Given by the British School of Archaeology in Egypt in 1906.
Reg. no. GR 1906,1020.4

Translucent amber disc with small rolled rim and suspension loop. Slightly right of centre is the standing figure of Isis, facing left in three-quarter view, holding a torch in her raised right hand and wearing a tight fitting cap with upright feathers. At left is an upright serpentine form topped by a diadem with projecting spikes (attribute of Helios). At far left and right are two 'blobs' (canopic jars?).
Cf. Sale catalogue 1978, no. 1, for a possible example.
Gems: No exact parallels are known, but for general compositional parallels see: Bonner 1950, no. 340; Zwierlein-Diehl 1992, no. 17; Michel 2001, no. 465. For a gem with a similar representation of Sarapis, see: *AGDS* I.3 no. 2663; for an upright snake with radiate lion's head, *cf.* Phillip 1986, Namensverzechnis: Chnoubis; on Isis' head ornament, *cf.* Phillip 1986, Sachverzeichnis: Kopfputz der Isis; On Isis' costume, *cf.* Hopfner 1921, §678 and §855. Further general compositional parallels can be observed on the group known as 'uterus' amulets, *cf.* Michel 2001, nos 359–79.

Iconography: The great Egyptian goddess, Isis was a complex, omnicompetent figure. As Osiris' sister-wife, the mother of Horus and of each incumbent pharoah, Isis mourned, nourished and protected the dead; she provided the vital link between gods and kings, and she wielded unparalleled power as a magician.[96] In the Hellenistic period Sarapis (also a multi-faceted figure) became one of Isis' companions,[97] and taken together, working in tandem, they symbolized dual avatars of limitless power. In Late Antiquity, the Levantine diffusion of the Isis cult (with or without Sarapis as her companion) was extensive, from the Syro-Palestinian littoral inland to the Tigris/Euphrates and south to Arabia.[98] In iconography Isis typically was shown dressed in a long, flowing dress and wearing a headpiece consisting of radiating solar rays (from Helios) or horns (from Hathor)[99] flanking a solar disc. Sarapis (embodying attributes of Dionysos, Helios and Zeus) was represented as a mature male figure, with long hair and a heavy beard.

In both this and the following example, Sarapis is exhibited as a theriomorph, under the guise of the chthonic and benevolent spirit (*genius*) called *Agathodaimon*;[100] he has the familiar bearded head set atop the body of a large serpent. Sarapis appears on the left side of the field. On the right, Isis is shown standing, facing left in profile, her right hand raised and holding an unidentified object (perhaps the *sistrum*). Protection against evil spirits is the symbolic meaning that the Late Antique wearer of this pendant is likely to have conjured. (PCF)

Unpublished.

8. Glass pendant

4th century
h. 22.7mm; w. 21mm; max d. of incuse approx. 16mm; wt 1.8g
Colour: L*a*b*42 12 30; Munsell 9YR 4/5
Reg. no. GR 1976,0916.4

Translucent amber disc with rolled rim and suspension loop. Slightly right of centre is the standing figure of Isis, facing left in three-quarter view, holding a torch in her raised right hand and wearing a tight fitting cap with upright feathers. At left is a serpentine form capped with a human head facing right wearing a diadem with three upright spikey projections (Helios diadem), probably intended to represent Sarapis. At far left and right are two 'blobs' (canopic jars?)
Cf. cat. no. 7.

Unpublished.

9. Glass pendant

4th century
h. 24.1mm; w. 20mm; max d. of incuse approx 15mm; wt 1.9g
Colour: L*a*b*43 6 14; Munsell 10YR 3/2
Reg. no. GR 1976,0916.3

Translucent discoloured amber disc with rolled rim and suspension loop. Winged Eros facing left astride a lion and holding a flail in raised right hand.
Cf. Petrie 1888, 80, pl. XLI.77 (from Defenneh, Egypt); Cambi 1974, no. br.II.15, 144 and 150 (from Solin, near Split); Barag 2002, no. LA-11, 312; Mandruzzato 2008, no. 137, 76 (from Aquileia).
Gems: Bonner 1950, 200, n. 78; Michel 2001, nos 257–8; *LIMC* 3.1, 952ff., nos 335–60.

Iconography: As with Isis, Eros (Lat. Amor, Cupido: personifying love) was a complex and polyvalent figure in Late Antiquity. In contrast to Isis, Eros had a much older mythopoetic Greek pedigree, but by the period of Late Antiquity Eros had been reduced to the status of a lesser *daimon* (ghost or spirit) inhabiting the demi-monde of Graeco-Roman popular culture. However, for a brief time, Apuleius rehabilitated Eros, lifting him into the ranks of neo-Platonic mystification and embellishing him with a patina of respectability, at least in Antonine literary circles. In iconography, however, during the middle and late Empire, Eros was visualized as a chubby little baby sprouting wings, and hence a figure of marginal import within the great iconographic stew that spilled over the Late Antique world. 'Marginal' is of course relative, and if we judge the matter statistically (based on the number of extant examples) then iconographic Eros must be moved up the chart because of his multiple appearances in Late Antique iconographic venues. In truth, it is difficult to evaluate this subject (for want of relevant textual evidence), but with iconographic Eros it is probably better to err on the minimalist side: the image lacked gravitas, and the pictorial weight of the image in Late Antiquity seems always to have been on the light side.

Eros riding the back of a wild animal (bear, bird, bull, butterfly, caprid, deer,

dolphin, eagle, elephant, goose, leopard, lion, panther, peacock, pig, swan), astride a fantasy creature (griffin, gryllos, hippalektryon) or riding a domesticated animal (camel, horse) is an iconographic commonplace in Late Antiquity.[101] Here Eros holds a flail (or whip) in his raised right hand; the identity of the animal that he rides is unclear. The specific symbolic association (if there was any) that the wearer of this pendant would have given to the Eros image cannot be determined. In a very general and very obvious sense, Eros riding the backs of animals prompts associations with the power of love. (PCF)

Unpublished.

10. Glass pendant

4th century
h. 18.2mm; w. 18mm; max d. of incuse 14mm; wt 1.1g
Colour: L*a*b*42 6 21; Munsell 2Y 4/4
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.82

Translucent amber disc with rolled rim and broken suspension loop. The draped figure of Diana/Artemis, facing front, flanked by caprids with backward-turned heads. She holds a quiver of arrows in her left and a compound bow in her right hand.
Cf. Cambi 1974, nos br.II.10 and br.II.17, 143–4 and 150 (from Solin, near Split).
Gems: Sena Chiesa 1966, nos 100, 2482–4; *LIMC* 2.1 618–753, 1394–1417; Michel 2001, no. 72.

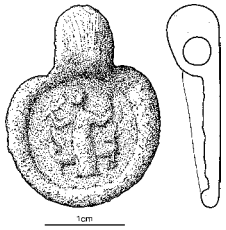
Iconography: Artemis was the most popular of the Greek female divinities. Her habitat comprised forests, river deltas and wetlands, where she was known as the 'mistress of animals' (*pótnia theron*). Her identity was complex, at once protector and destroyer, nurturing mother (assimilated at various times and places to other female sustainers such as Bendis, Demeter, Eileithyia, Isis, Kybele) and vengeful hunter, deliverer of harsh punishments forced on those who infringed Greek laws governing chastity, virgin enforcer bent on revenge against those who would dishonour her mother Leto – in this last-named, guise, chthonic enforcer hell-bent on revenge, Artemis was frequently assimilated to Hekate.[102]

On this pendant Artemis is depicted standing, facing front, dressed in a long flowing tunic which falls to the ground. She holds a quiver of arrows in her raised right hand, a bow in her left and she is flanked by stags. Cat. nos 10–11 presents the same subject matter, albeit in a degraded form – this is probably to be explained as the result of a die sloppily applied to the vitreous gather. In both of these examples she is presented in the traditional composition thought to embody *pótnia theron*: the goddess stands in the center of the field, facing front, animals flanking her left and right.[103] (PCF)

Unpublished.

11. Glass pendant

4th century
Provenience: Egypt.
h. 25mm; w. 19mm; max d. of incuse 12mm; wt 1.8g
Bought from the Rev. G.J. Chester in 1882.
Reg. no. AES 1882,1127.30 (13397)



Translucent pale yellow disc with rolled rim and suspension loop. An indistinct design which probably represents the draped figure of Diana/Artemis flanked by two caprids with backward-turned heads. She holds an object in either hand, presumably a bow and arrow.
Cf. cat. no. 10.

Unpublished.

12. Glass pendant

4th century
Provenience: 'acquired' in Jerusalem.
h. 21mm; w. 15mm; max d. of incuse approx. 8.5mm; wt 2.0g
Colour: L*a*b*34 -3 7; Munsell 1GY 4/2
Bought from the Rev. G.J. Chester in 1867.
Reg. no. ANE 1867,0915.109 (running no. 102928)

Translucent light green disc with rolled rim and suspension loop. An indistinct design which may represent Diana/Artemis flanked by two animals.
Cf. cat. no. 10.

Unpublished.

13. Glass pendant

4th century
h. 17.8mm; w. 20.5mm; max d. of incuse 16mm; wt 1.5g
Colour: L*a*b*44 10 29; Munsell 10YR 4/6
Reg. no. PE 1983,1108.51

Translucent amber disc with rolled rim and broken suspension loop. At right a winged figure wearing a soft cap guiding a massive stag with a large rack of antlers walking to left and reaching out to touch the animal's hind quarters.
Cf. Fol 1875, no. 2191, 194; Petrie 1888, 80, pl. XLI.81 (from Defenneh, Egypt); Martiniani-Reber 2011, no. 170, 235.
Gems: *AGDS* 1.3 no. 2769; *LIMC* 2.1 nos 617–53.

Iconography: This is probably to be read as a rendering of Artemis turning Aktaion into a stag (Ovid, *Met.* 3.276–280) – this was her punishment for his ogling the naked nymphs bathing in a stream.[104] The uncertainty in this interpretation centers on the winged figure, who resembles Hermes more than Artemis. (PCF)

Unpublished.

14. Glass pendant

4th century
h. 23.8mm; w. 18mm; max d. of incuse approx. 12mm; wt 1.5g
Colour: L*a*b*44 5 24; Munsell 2Y 4/4
Reg. no. PE 1983,1108.46

Translucent amber disc with rolled rim and suspension loop. A draped female figure wearing a tunic and veil and holding a rudder in her right hand and possibly a Victory in her left; in the field to left, a palm branch; to right, a cornucopia.
Cf. Whitehouse 2003, no. 870 who tentatively identifies the figure as Roma; Mandruzzato 2008, no. 135, 76 (from Aquileia) where the figure is identified as Athena. There is an unpublished example from Carthage in the Glasmuseum in Wertheim (Haeverninck collection: THE 2820).
Gems: Sena Chiesa 1978, no. 81 (Isiac head ornament); *AGDS* 1.3 no. 2279; *LIMC* 8.1 'Tipo grande madre' ad. loc. 1b-3, 9+c, 16, 18a+b.

Iconography: Tyche (Lat: Fortuna) is the personification of chance, destiny, fate, fortune, lot, luck, providence. The iconography here shows a standing figure facing front (turned slightly to her left, the viewer's right). She wears a full and long belted tunic which falls to the ground, and her head is covered with a veil (or mantle, scarf, shawl: resembling the Roman priestly headcover – Tellus-Italia also wears this headcover on the relief left of the entrance portal on the east end of the Ara Pacis).[105] The figure holds a rudder (Lat: *gubernaculum*) with her right hand, and farther to the left along the annular rim of the incuse field there is a palm frond. Her left arm is extended, and an unidentifiable object sits on the palm of her right hand; beneath the extended left arm, close to the hem of the tunic, there is a triangular object, probably best interpreted as the cornucopia[106] which is Tyche's second traditional attribute.[107]

The headcover is problematic. When and if her head is covered, normally Tyche wears a *polos* (pillbox hat) or a crenellated (turreted) crown signifying a city wall.[108] In the latter examples, which are well-known to students of Late Antiquity, Tyche personifies the good fortune of especially prosperous municipalities. There are a few examples of Tyche-Fortuna wearing a head cover paralleling the one above.[109] These are all examples suggesting the assimilation of Tyche-Fortuna to other maternal types, including Demeter, Isis and Kybele. On this pendant, Tyche-Fortuna may have been intended as an avatar of maternal succour. (PCF)

Unpublished.

15. Glass pendant

4th century
h. 22.2mm; w. 15.3mm; max d. of incuse approx. 12.5mm; wt 1.4g
Colour: L*a*b*35 9 15; Munsell 5YR 3/2
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.83

Translucent amber disc with rolled rim and suspension loop. A frontal female bust wearing a diadem and earrings; in the field to left, NI; to right, KH. Both this and the following example may have been stamped with the same die.
Cf. Overbeck 1971, 134, pl. 15.7; *AGDS* I.3 no. 3540; Lees-Causey 1983, no. 4, 154–5, figs 4–7; Şovan 1987, fig. 2, no. 10 which is republished in: Exhibition catalogue 1994, no. I. 31g, 105 (from a cemetery at Mihălăşeni, Romania); Sale catalogue 1989, no. 276, 76–7; Preda 1980, no. M 236.2, 104 and pls 26 and 77 (from grave 236 in a cemetery in Callatis, Romania); *AGWien* III no. 2502 for an almost identical bust, but apparently inscribed: AGIS WNY; Barag 2001, no. 356, 179, pl. 29; Barag 2002, no. LA-17, 314.
Gems: *cf.* Tyche *LIMC* 6.1 850ff; Victoria: *LIMC* 8.1 237–68.

Iconography: As with Tyche, Nike is the personification of an abstract concept, in this case victory in warfare. In Greek iconography (beginning in the early 6th century BC) Nike is usually rendered as a standing, winged female figure.[110] In the West, Latin renderings of Nike (under the name Victoria) continued the Greek iconographic tradition.[111] There is a Hellenistic (numismatic) tradition of representing just the bust of Nike (but usually in profile, not frontally),[112] and no doubt this is the distant prototype of the Late Antique Nike busts represented on this and the following example. (PCF)

Unpublished.

16. Glass pendant

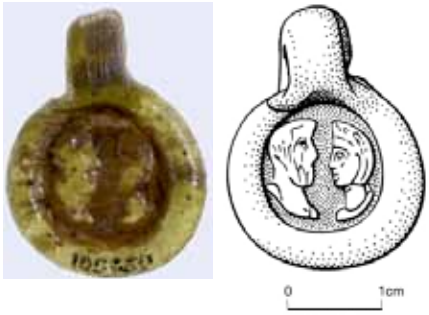
4th century
Max d. 16.3mm; max d. of incuse approx. 12.5mm; wt 1.0g
Colour: L*a*b*43 6 23; Munsell 1Y 4/2
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.84

Translucent amber disc with rolled rim; suspension loop missing. A frontal female bust wearing a diadem and earrings; in the field to left, NI; to right, KH.
Cf. cat. no. 15.

Unpublished.

17. Glass pendant

4th century
h. 21mm; w. 16mm; max d. of incuse 10mm; wt 1.3g
Colour: L*a*b*69 -3 4; Munsell 10YR 5/2
Coated
Given by Mrs H.H. Way in 1905.
Reg. no. ANE 1905,0513.9 (running no 100660)



Translucent green disc with rolled rim and suspension loop; extensive surface iridescence. At left a profile male bust facing right, at right a profile female bust facing left.
Cf. Wulff 1909, no. 1155, 235, pl. 56; Eisen and Kouchakji 1927, pl. 131 (two examples); Cambi 1974, no. br.II 6, 142 and 149 (from Solin, near Split); Zouhdi 1978, no. Ib, 54–5 (ten examples, seven of which are from Hauran, Syria, and which he considers to have been stamped with the same die); Sale catalogue 1978, no. 11 (where the busts are identified as Otacilia and Philip I); Vollenweider 1979, no. 262, 250, pl. 80; Bertoncelj-Kučar 1978, no. T.2:10, 260 and 271, pl. T.2; Sale catalogue 1989, no. 288, 76 and 79, but inscribed ZOH in the field; Hoey Middleton 1998, no. 44, 55; Barag 2001, nos 380a-b, 182, pl. 30, also inscribed ZOH; Barag 2002, nos LA-24 – LA-26, 316–17; Whitehouse 2003, no. 879 (inscribed ZOH) and 904 (with a cross above their heads); Wamser 2004, no. 601, 319; Mandruzzato 2008, nos 139–40, 76–7 (from Aquileia); Gasparri 2009, no. 127.18, 287, fig. 15; Martiniani-Reber 2011, no. 172, 236. There is also an unpublished example in the C.S. collection in Munich (no. 1538). For 'trilobitenperlen' with the same juxtaposition of male and female busts see: Haeverninck 1973, pl. 1: 10, 14; pl. 2:7–8; Mandruzzato 2008, nos B4a – B4c, 162; Arveiller-Dulong and Nenna 2011, nos 63–4.
Gems: Henig 1975, no. 355 (modern?); Krug 1980, no. 389; *AGWein* III no. 1733 (modern?); Spier 2007, nos 79, 451 and 579.
Coins: Carson 1980a, no. 789, 95 (antonianus of Philip I and Otacilia, AD 247).

Iconography: This and the following four pendants show opposing (or confronting) profiles of a male and female coiffure provides the criterion of gender differentiation (as it does of dating: the so-called 'Scheitelzopf' points to a late-3rd to mid-4th century context); in three examples (cat. nos 17, 19, 20) the female is on the right, and in one (cat. no. 18) the order is reversed. In the fifth example (cat. no. 21) there is no gender differentiation – here both heads are topped with so-called Phrygian caps.

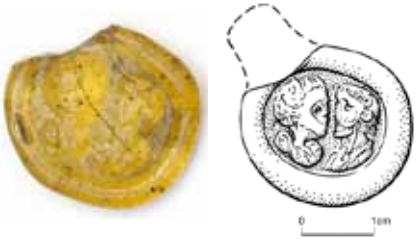
The iconographic tradition represented here plays a conspicuous role on 4th-century portables (coins, engraved gemstones, finger-ring bezels, medals). The well-known Christianized version (mid-4th century) of the type shows opposing apostle busts (e.g. Peter and Paul),[113] but the primary iconographic model is secular. When the busts are male and female (as they are in four of our five examples), cataloguers generally classify the subject under the rubric 'Marriage', in other words these are thought to be spouses gazing at one another in marital harmony.[114] Several examples survive especially on square or rectangular metal (precious and base) finger-ring bezels dating between AD 300 and 400.[115] One well-known Christianized version of the secular model involves the emplacement of a cross between the foreheads of the two gazing spouses. One of the most famous examples of this adaptation is the splendid gold ring from the Franks collection in the British Museum (see below).[116] There are no crosses or other devices pointing

to Christianity on the examples here, hence we must infer secular (or pagan) intentions. (PCF)

Unpublished.

18. Glass pendant

4th century
Provenience: Egypt.
Max d. 18.8mm; max d. of incuse 13mm; wt 1.2g
Colour: L*a*b*48 4 47; Munsell 4Y 4/5
Given by the executors of Felix Slade in 1871.
Reg. no. GR 1871,0616.35

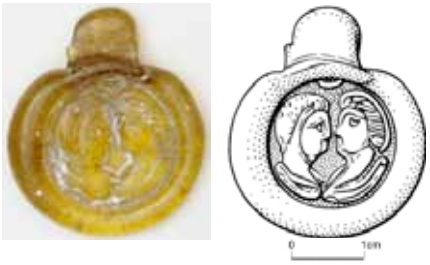


Translucent amber disc with rolled rim; suspension loop missing. At left a profile female bust facing right, at right a profile male bust facing left.
Cf. cat. no. 17.

Unpublished.

19. Glass pendant

4th century
Provenience: Palestine (perhaps Jerusalem).
h. 23.3mm; w. 20mm; max d. of incuse 13mm; wt 2.1g
Colour: L*a*b*44 5 25; Munsell 4Y 5/5
Given by P.H. Ellis in 1895.
Reg. no. PE 1895,1219.1

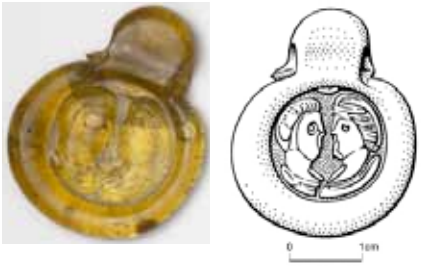


Translucent amber disc with rolled rim and suspension loop. At left a profile male bust facing right, at right a profile female bust with 'Scheitelzopf" facing left; above their heads, a crescent. Both this and the following example may have been stamped with the same die.
Cf. cat. no. 17 for the general type.

Unpublished.

20. Glass pendant

4th century
h. 25.3mm; w. 20mm; max d. of incuse 13mm; wt 2.3g
Colour: L*a*b*57 3 38; Munsell 4Y 5/4
Given by Sir Augustus W. Franks in 1896.
Reg. no. PE 1896,0616.1

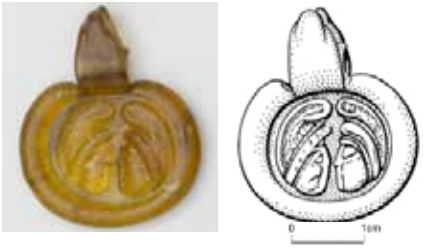


Translucent pale yellow disc with rolled rim and suspension loop. At left a profile male bust facing right, at right a profile female bust with 'Scheitelzopf" facing left; above their heads, a crescent.
Cf. cat. no. 17 for the general type.

Unpublished.

21. Glass pendant

4th century
h. 22.7mm; w. 18.7mm; max d. of incuse 13.5mm; wt 1.6g
Colour: L*a*b*44 9 27; Munsell 0Y 4/4
Reg. no. PE 1983,1108.45

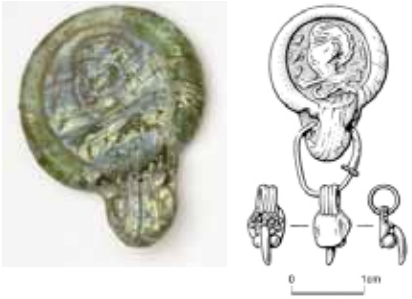


Translucent amber disc with rolled rim and suspension loop. Two opposing profile busts, both male, wearing Phrygian caps.
Cf. Bertrand 2000, 71–101 (from Antigny, France); Barag 2002, nos 363–4a, 180, pl. 29; Foy 2009, 126, fig. 25 for a variant from Saint-André de Sangonis, France.

Unpublished.

22. Glass pendant

4th century
Provenience: a tomb near Amiens, France.
h. 25.1mm; w. 19mm; max d. of incuse 13.5mm; wt 3.1g
Colour: L*a*b*63 -10 8; Munsell 10GY 5/2



Coated
Formerly in the Londesborough Collection.
From the Franks Bequest; acquired in 1897.
Reg. no. GR 1917,0601.2944

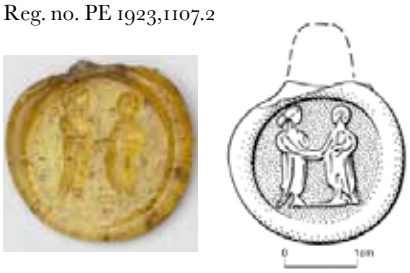
Translucent discoloured green disc with rolled rim and suspension loop attached to a gold ring with phallos; the glass is highly iridescent with exfoliating surfaces. An upside down female bust to left; in front of her, three indeterminate motifs, one perhaps a star; behind her head, a further indeterminate object.
Cf. For two *trilobitenperlen* with a not dissimilar female bust, see Mandruzzato 2008, nos B3a and 3b, 162. For glass pendant phalloses, see Spaer 2001, no. 426, 186–7.
Gems: Sena Chiesa 1978, nos 118–20 (prototypes facing left).

Iconography: The bust is displayed in three-quarters view, with the 'Scheitelzopf' fully exposed. The pendant phallos suggests a marital association; in popular culture during the period of Late Antiquity, the image of the phallos functioned as an apotropaic device and as a sign of good fortune.[117] (PCF)

Published: Conyngham 1849, 174, pl. VII.5; Marshall 1969, no. 2944, 351.

23. Glass pendant

4th century
Max d. 18.8mm; max d. of incuse 14mm; wt 1.2g
Colour: L*a*b* 58 4 36; Munsell 4Y 6/5
Given by Col. The Hon. M.G. Talbot CB in 1923.
Reg. no. PE 1923,1107.2



Translucent pale yellow-brown disc with rolled rim; suspension loop missing. Two opposing draped figures holding (right) hands (*dextrarum iunctio*); at left, female, at right male.
Cf. Vollenweider 1979, no. 249, 239–40, pl. 77 (dated to the second half of the 2nd century on the basis of coin parallels); Raynaud 2001, no. 385, 215, and Foy 2009, 125, fig. 24 (from tomb 40 of the cemetery at Lunel-Viel in France, dated to the 4th century); Mandruzzato 2008, no. 138, 76 (from Aquileia); Martiniani-Reber 2011, no. 171, 236.
Gems: Sena Chiesa 1966, nos 949–59; Henig 1978, nos 349–9; *AGDS* 1.3 no. 3316; *AGWien* III nos 1090–1; Krug 1980, no. 355.
Coins: Carson 1980a, nos 977, 981, 987, 128–30 (three antoniani of Aurelian, AD 271–5). See **Pl. 10** for an example.

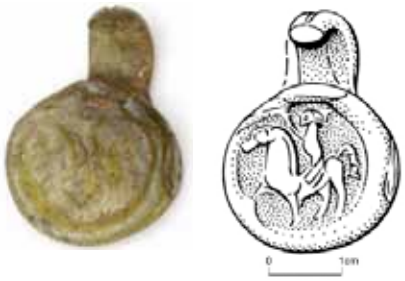
Iconography: The joining of right hands (*dextrarum iunctio*) between genders signifies marital harmony ('concordia maritalis': *Cod. Iust.* 6.25.5,1).[118] There is also an iconographic *dextrarum iunctio* signifying political unity, but

in the present context the image, which was worn on the body of the owner, probably functioned primarily as a marker of personal and private meanings. (PCF)

Unpublished.

24. Glass pendant

4th century
Provenience: Beirut.
h 21.8mm; w. 16mm; max d. of incuse approx 11mm; wt 1.6g
Colour: L*a*b*35 0 10;Munsell 4Y 3/2
Coated
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.11



Translucent green disc with rolled rim and incomplete suspension loop. A rider facing left with upraised right arm.
Cf. No known parallels.
Gems: *AGWien* III no. 1709.

Iconography: Male figures on horseback have a long and rich history in ancient iconography. This pendant shows a rider with his right arm raised. This is a much-debased example of a familiar Roman iconographic type, of which the most famous example is the late 2nd-century bronze equestrian statue of Marcus Aurelius displayed in Michelangelo's piazza in front of the Roman Capitol.[119] Clearly this type served the interests of military-political propaganda, and it was repeated many times over in a wide range of contexts (including funerary reliefs),[120] throughout Late Antiquity, in multiple cultural settings, many of them Christian.[121] One of the more spectacular 4th-century examples is the large (39.78g) gold medallion struck at Ticinum in the year AD 313.[122] The image on the reverse of the medallion shows Constantine on horseback, his right hand raised, awash in military attributes: a spear in his left hand, Nike-Victoria holding a victory crown and a palm frond (= peace following conquest), Virtus (manly valour) wearing a military helmet, holding a lance and a military standard. Along the upper rim of the medallion, an inscription identifies the scene as an 'adventus' (an appearance or arrival of an important figure, in this example: Constantine the conquering emperor).[123] It is clear that the image on this pendant evokes a distant prototype rooted in the iconography of triumphant Roman horsemen, however that is all that is clear – there is no way to know what meanings the owner of the pendant may have attached to this image. (PCF)

Unpublished.

25. Glass pendant

4th century
Provenience: Egypt.
Max d. 18.7mm; max d. of incuse 12.5mm; wt 1.2g
Colour: L*a*b*31 -8 -3; Munsell 1B 2/3
Bought from the Rev. G.J. Chester in 1879.
Reg. no. GR 1879,0522.48

Translucent blue disc with rolled rim; suspension loop missing. At right of centre a seated draped figure with upraised arm grasping a sword displayed horizontally; left of centre twelve superimposed figures, four to a row. Christ and his apostles. Both this and the following example may have been stamped with the same die.
Cf. Chabouillet 1858, no. 3475, 610; Garrucci 1880, pl. 479, fig. 20 (from Syria); Cambi 1974, no. br.II 21, 144 and 150–1 (from Solin, near Split); Vollenweider 1979, no. 261, 248–9, pl. 80; Sale catalogue 1989, no. 269, 76–7; Stiegemann 2001, no. IV.18.5, 300–1; Whitehouse 2003, no. 925 who tentatively identifies the scene as the miracle of the loaves and fishes; Martiniani-Reber 2011, no. 173, 237. There is also an unpublished example in the C.S. collection in Munich (no. 1111). For a slight variant in which the figure of Christ with upraised right arm is seated and flanked by six standing apostles and inscribed in Greek: IHC | OV (Ιησου), see: Cambi 1974, no. br.II. 20, 151 (from Solin, near Split); Campbell 1985, no. 281; Barag 2002, no. LA-19, 314–15. Another unpublished variant in which Christ stands frontally with upraised left arm and flanked by three apostles on either side is in the C.S. collection in Munich (no. 2635).

Iconography: In this and the following two examples the Christ figure appears in the right half of the incuse field; he is seated, facing left, dressed in a *pallium*, his right hand raised in a gesture of speech (or teaching). His audience consists of apostles gathered in the left half of the field. In this and cat. no. 26 there are twelve round blobs signifying the heads of the apostles; cat. no. 27 is degraded, and hence the definition of the individualized heads of apostles difficult to read. In all three examples, there is a long horizontal hasta with a short vertical cross-bar above the right hand of the Christ figure – this could be interpreted as a cross or a sword. The visual evidence would appear to point to the latter interpretation, in which case this may constitute a visual play on Matthew 10:34: 'Do not think that I have come to bring peace to the earth, I have not come to bring peace, but a sword'. This saying is part of larger narrative sequence in which the evangelist portrays Jesus as a teacher (*didaskalos*). However, if the intention here is to show Jesus holding a sword over his head (perhaps the double-edged sword of Hebrews 4:12?; *Cf.* Revelation 1:16), then on iconographic grounds this is an unusual detail – there is no contemporaneous (4th century) parallel iconographic evidence to corroborate this interpretation.

Variants, such as a pendant in Berlin, also exhibit Christ as a teacher, but the compositional arrangement is different. The Christ figure sits facing front at the center; the figure is oversized in relation to the flanking, standing figures, and in effect the seated teacher bisects the entire incuse field (although there is some empty space in the exergue beneath his feet). His right hand is also raised in a speaking-teaching gesture. Left of the teacher there are three standing figures, and there are three on the right – this is pictorial shorthand for the twelve apostles. Along the upper rim of the incuse field there is a *titulus* (label) consisting of five characters (read from right to left) which spells out the name of Jesus in Greek (I H C | O V), but the sixth letter (Σ or C) of the name is missing. In short, the identity of the seated figure here is clear. What is less clear here is his teaching role (the sword, an unambiguous marker of pedagogical intent, is missing).

In Early Christian iconography, we have multiple examples of the Christ figure assimilated to generic types (healer, judge, legislator, king, philosopher, shepherd, teacher). The protagonist is often portrayed seated (a position of authority) and facing front, flanked by subordinates. That this was an important image to Early Christians is clear from the privileged emplacement accorded images of the seated Christ in extant programmes of apse decoration within Early Christian basilicas. From the late 4th century onwards, painted and tessellated images of Christ seated, facing front and flanked by disciples appear in the concave quarter dome over the sanctuary of a basilica.[124] In these pendants, the visual conceit has been transposed to a small, private, movable tableau, one that was worn on the body. It would be reasonable to infer that many of the associations prompted by the iconography of the seated Christ-teacher appearing in the public setting of a church were carried over here to the private world of images worn on the body, namely the justice, majesty and wisdom of God. (PCF)

Unpublished.

26. Glass pendant

4th century
h. 24.4mm; w. 19.9mm; max d. of incuse 13mm; wt 1.6g

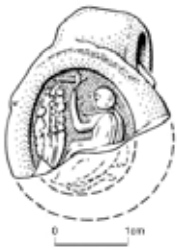
Colour: L*a*b*31 -9 -1; Munsell 6B 2/4
Reg. no. PE 1983,1108.50

Translucent blue-green disc with rolled rim and suspension loop. At right of centre a seated draped figure with upraised arm grasping a sword displayed horizontally; left of centre twelve superimposed figures, four to a row. Christ and his apostles.
Cf. cat. no. 25.

Unpublished.

27. Glass pendant

4th century
h. 19mm; w. 14.5mm; wt 1.4g
Colour: L*a*b*79 4 16
Reg. no. ANE running no. 102945



Incomplete disc (about half missing) with rolled rim and suspension loop; the highly iridescent surface obscures the colour. At right of centre a seated draped figure with upraised arm grasping a sword displayed horizontally; left of centre twelve superimposed figures, four to a row. Christ and his apostles.
Cf. cat. no. 25.

Unpublished.

28. Glass pendant

4th century
h. 23mm; w. 20.2mm; max d. of incuse 13mm; wt 1.8g
Colour: L*a*b*51 3 26; Munsell 4Y 6/5
Reg. no. PE 1983,1108.47

Translucent yellow disc with rolled rim and suspension loop. A standing shepherd, facing front, head turned to left, carrying an oversized ram (shepherd-kriophoros) and flanked by sheep facing toward the outer rim of the incuse field with heads turned back.
Cf. Wulff 1909, no. 1154, 236, pl. 56; Orsi 1912, 209, fig. 40a (from Sicily); Eisen and Kouchakji 1927, pl. 131; Cabrol and Leclercq 1938, no. 314, col. 2385, fig. 9955; Cambi 1974, nos br.II 18 and 19, 144 and 150, (from Solin, near Split); possibly von Saldern 1980, no. 218, 33, pl. 22 (from Sardis); Sale catalogue 1989, no. 275, 76–7; possibly Henig 1994, no. 550, 255 (from Amanthus, Cyprus); Barag 2001, no. 369, 180, pl. 29; Stiegemann 2001, no. IV.18.1, 300–1; Barag 2002, no. LA-20, 315; Whitehouse 2003, no. 900. There are also two unpublished examples in the C.S. collection in Munich (nos 2633–4).
Gems: Provoost 1976/1, nos 801–911; Henig 1978, no. 361; Zazoff 1983, nos 382–4; Spier 2007, nos 318–408 for the basic type and numerous variations, including nos 398–404 which are glass intaglios.

Iconography: This and the following five examples all exemplify the same iconographic type: a standing male figure dressed in a short tunic, head turned left, carrying a large ram (Gk. κριός) on his back and shoulders; flanking the central figure: opposing sheep facing away from the center of the incuse field, their heads turned back toward the center. In antiquity, the type had a long history, in both ancient Near Eastern and western (Indo-European) iconographic traditions.[125] In the 3rd and 4th centuries, the type appears often in Early Christian iconographic contexts.[126] In an anti-Pharisaic pericope (Luke 15:3–6), Luke the evangelist describes a shepherd who finds a lost sheep; he lifts the animal onto his shoulders and carries it back home. From an early point in the history of biblical exegesis, interpreters have identified Jesus under the generic image of a so-called good shepherd (*poimen kalos*: John 10:11 and 14).[127] Given a 4th-century Levantine setting, the shepherd image on these pendants may well have evoked associations with Jesus. In cat. no. 33, on the left side of the incuse field the Greek cross over the head of the sheep lends weight to the probability that the shepherd in question is Jesus the *poimen kalos*. In many parts of the Roman Empire, over the course of the 4th century, this image had won instant recognition as a marker of Christian identity. (PCF)

Unpublished.

29. Glass pendant

4th century
Provenience: said to be from Cyprus.
h. 23mm; w. 20.2mm; max d. of incuse 14mm; wt 2.4g
Colour: L*a*b*41 4 21; Munsell 3Y 4/3
From the Cesnola Collection. Given by the executors of Felix Slade in 1871.
Reg. no. PE 1871,0123.6

Translucent yellow disc with rolled rim and suspension loop. A very blurred impression of a standing shepherd-kriophoros, similar to cat. no. 28.
Cf. cat. no. 28.

Published: Dalton 1901, no. 698.

30. Glass pendant

4th century
Max d. 18.8mm; max d. of incuse 14mm; wt 1.4g
Colour: L*a*b*34 10 17; Munsell 7YR 3/5
Reg. no. PE 1983,1108.48

Translucent brown disc with rolled rim; suspension loop missing. A standing shepherd-kriophoros, similar to cat. no. 28. Both this and the following two examples may have been stamped with the same die.
Cf. cat. no. 28.

Unpublished.

31. Glass pendant

4th century
Provenience: Alexandria, Egypt.
Max d. 19.5mm; max d. of incuse 14.5mm; wt 1.5g
Colour: L*a*b*36 11 20; Munsell 8YR 3/4
Bought from the Rev. G.J. Chester in 1881.
Reg. no. PE 1881,0719.33

Translucent amber disc with rolled rim; suspension loop missing. A standing shepherd-kriophoros, similar to cat. no. 28.
Cf. cat. no. 28.

Published: Dalton 1901, no. 699.

32. Glass pendant

4th century
Provenience: Egypt.
Max d. 19.2mm; max d. of incuse 14.5mm; wt 1.5g
Colour: L*a*b* 34 11 16; Munsell 6YR 3/4
Bought from the Rev. G.J. Chester in 1883.
Reg. no. PE 1883,0621.16

Translucent brown disc with rolled rim; suspension loop and top left-hand part missing. A standing shepherd-kriophoros, similar to cat. no. 28.

Cf. cat. no. 28.

Published: Dalton 1901, no. 700.

33. Glass pendant

4th century
Max d. 20.2mm; max d. of incuse 15mm; wt 1.7g
Colour: L*a*b*40 10 26; Munsell 9YR 4/4
Bought from E.P. Triantaphyllos in 1900.
Reg. no. PE 1900,1016.2

Translucent brown disc with rolled rim; suspension loop missing. A standing shepherd-kriophoros flanked by two stylized sheep; in the upper left field, a cross.
Cf. cat. no. 28.

Published: Dalton 1901, no. 697; Cabrol and Leclercq 1938, no. 316, col. 2385.

34. Glass pendant

4th century
Provenience: said to be from Cyprus.
h. 21.1mm; w. 15.8mm; max d. of incuse 11mm; wt 1.5g
Colour: L*a*b*27 0 -1; Munsell 1PB 2/1
From the Cesnola Collection. Given by the executors of Felix Slade in 1871.
Reg. no. PE 1871,0123.10

Translucent blue disc with rolled rim and suspension loop. A diminutive orant figure wearing a tunic, flanked by two animals with backward-turned heads. Daniel and the lions. Both this and the following example may have been stamped with the same die.
Cf. Eisen and Kouchakji 1927, pl. 131; Spartz 1967, no. 160c, pl. 38; possibly von Saldern 1980, no. 218, 33, pl. 22 (from Sardis); Boosen 1984, no. 192, 92; Opaiţ 1984, 337–8, pl. I.2, 696 (from Badadag-Topraichioi, near Dobrogei, Romania); Şovan 1987, 227–34, fig. 2, no. 9 which is republished in: Exhibition catalogue 1994, no. I. 31g, 105 (from a cemetery at Mihălăşeni, Romania); Zwierlein-Diehl 1991, no. 2500, 225–6, pl. 158; Sale catalogue 1994, no. 829, 116, pl. 42; Wamser and Zahlhaas 1998, no. 111, 106 and 108; Baldini Lippolis 1999, no. 1, 143 (from Syria); Westenholz 2000, nos 107–110, 126–7; Barag 2001, no. 368, 180, pl. 29; Stiegemann 2001, no. IV.18.4, 300–1; Barag 2002, no. LA-5, 310–11; Gopkalo 2008, pl. 4, no. 12 (from a cemetery at Nagornoe, oblast Odessa, Ukraine; but for a better image see: Schultze and Gudkova 2012). There is also a similar example in the C.S. collection in Munich (no. 0517). For similar lead *bullae* depicting Daniel between two lions, see: Westenholz 2000, nos 112–14, 128.
Gems: Bonner 1950, no. 332; Spier 2007, nos 424–8, 437.

Iconography: This and the following three examples also exemplify an iconographic type, although its pedigree is not as ancient as that of the shepherd-kriophoros. The prophet is shown standing, facing front, wearing a short tunic (tunic *exomis*: a sign of a low-status person, beltless and long-sleeved in cat. no. 36), his arms extended in the so-called orant (prayer) posture. Left and right of the central standing figure are flanking lions, their torsos facing away from the center of the incuse field, their heads turned back toward the central figure. This iconographic type is based on Dan. 7:17–24 (*cf.* 14:31), part of the original Hebrew/Aramaic narrative which depicts Daniel in the lions' den. Given the evidence as we have it, probability favours the Christian invention of this iconographic type – there is no contemporaneous Jewish iconography to support a theory of its Jewish origins.[128] Barag classifies the glass pendant stamped with Daniel 'Judaic'[129] – this implies Jewish manufacture and ownership, which cannot be demonstrated and is highly improbable given the Christian invention and transmission of Daniel iconography throughout Late Antiquity. In cat. no. 37, the cross over the prophet's left arm lends further weight to the identification of the image as a Christianized version of Daniel. (PCF)

Published: Dalton 1901, no. 701.

35. Glass pendant

4th century
Provenience: said to be from Cyprus.
h.18.9mm; w. 15.8mm; max d. of incuse 11mm; wt 1.3g
Colour: L*a*b*24 1 -3; Munsell 5PB 2/1
From the Cesnola Collection. Given by the executors of Felix Slade in 1871.
Reg. no. PE 1871,0123.11

Translucent blue disc with rolled rim and suspension loop. A diminutive orant figure wearing a tunic, flanked by two animals with backward-turned heads. Daniel and the lions.
Cf. cat. no. 34.

Published: Dalton 1901, no. 702.

36. Glass pendant

4th century
h. 20.9mm; w. 16.9mm; max d. of incuse approx. 10mm; wt 1.7g
Colour: L*a*b*29 1 -4; Munsell 8PB 3/1
Coated
Bought from J.R. Ogden & Sons Ltd in 1981.
Reg. no. PE 1981,0601.11

Translucent blue disc with rolled rim and suspension loop. An orant figure flanked by two stylized animals. Probably Daniel and the lions.
Cf. cat. no. 34.

Unpublished.

37. Glass pendant

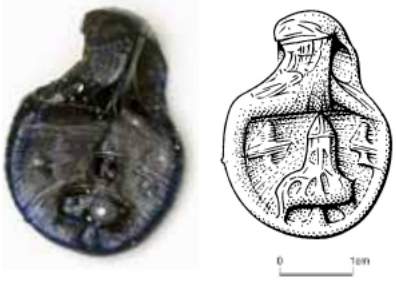
4th century
h 20.8mm; w. 19.3mm; max d. of incuse 13.3mm; wt 2.2g
Colour: L*a*b*48 3 32; Munsell 5Y 5/5
Transferred from the Department of Coins and Medals in 1986.
Reg. no. PE 1986,0609.25

Translucent lime green disc with rolled rim and broken suspension loop. An orant figure with head turned slightly to left flanked by two animals; in the upper left field, a cross. Probably Daniel and the lions.
Cf. cat. no. 34.

Unpublished.

38. Glass pendant

Syria (?), 5th–6th century
h. 20.8mm; w. 15mm; max d. of incuse approx 12mm; wt 1.5g
Colour: L*a*b*28 1 -1; Munsell 7PB 2/1
Bought from the Rev. G.J. Chester in 1884.
Reg. no. GR 1884,0509.7



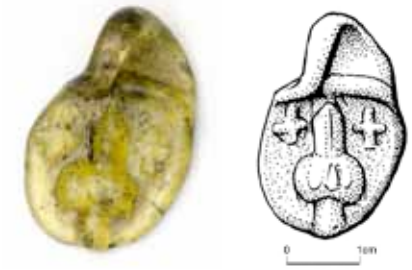
Translucent blue disc with slight rim and suspension loop. A stylite saint in the form of a crude frontal bust with conical hat surmounting an oblong pillar; in the field, two crosses. Both this and the following example may have been stamped with the same die.
Cf. Eisen and Kouchakji 1927, pl. 131, fig. 230, 533 (two examples); Merlat 1949, no. 1, 721–2 (from near Antioch); Lafontaine-Dosogne 1967, no. 17, 158, pl. 46, fig. 95 (from Antioch); Philippe 1970, 37, fig. 13; Cambi 1974, no. br. II.24, 145 and 151 (from Solin, near Split); Zouhdi 1978, no. IIb, 61 (four examples: two from Kefer Ra, near Hama, one from Kefer-Zeit, one from Jisr el-Abiad, Damascus); Sale catalogue 1989, no. 273, 76–7; Vikan 1995, 574–5, fig. 6; Wamser and Zahlhaas 1998, no. 112a-b, 106 and 108; Stiegemann 2001, nos 1.69.1-1.69.5, 185–7; Barag 2001, no. 376, 181, pl. 30 (inscribed in the field [CYM] EWN); Barag 2002, LA-21, 316; Mandruzzato 2008, no. 151, 78 (from Aquileia), but without the crosses; Giovannini 2010, no. 1, 133, fig. 1, 141 (from Trieste: four examples); Arveiller-Dulong and Nenna 2011, no. 90, 60.

Iconography: This and the following pendant show highly abstracted versions of pillar saints – iconographic details are obscure; a useful parallel is given in a *eulogia* token in the British Museum (see **Pl. 11**, p. 164).[130] The main iconographic marker is the conical hat worn by Syrian stylites – this is evident in both pendants. Pillar piety in Late Antiquity was a Syrian-Christian phenomenon.[131] Ascetics stood atop pillars day and night, week-in and week-out, with their arms extended in the orant posture, representing themselves as living icons, metamorphosed as if participating in an angelic liturgy. These two pendants are quite specific to a particular time and place: Syria in the 5th and 6th centuries. It would be reasonable to infer that the wearers of these pendants were attached in some way to stylite spirituality; they may even have been pilgrims to the great stylite sanctuary at Qal'at Sem'an.[132] It is entirely possible that at this pilgrimage location vendors dispensed glass pendants of the type envisaged here. (PCF)

Unpublished.

39. Glass pendant

Syria (?), 5th–6th century
h. 20.2mm; w. 13.5mm; max d. of incuse approx 13mm; wt 1.1g
Colour: L*a*b*40 0 16; Munsell 7Y 4/3
Bought from the Rev. G.J. Chester in 1884.
Reg. no. GR 1884,0509.8



Translucent green disc with suspension loop. A stylite saint in the form of a crude frontal bust with conical hat surmounting an oblong pillar; in the field, two crosses.
Cf.cat. no. 38.

Unpublished.

40. Glass pendant

Syria (?), 5th–6th century
Provenience: Amrit, Syria.
h. 25.8mm; w. 14.5mm; wt 2.0g
Colour: L*a*b*32 0 10; Munsell 5Y 3/1
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.12

Translucent light green disc with slight rim and suspension loop. Two figures with, above and between their heads, a cross. The figure on the left resembles a stylite saint with a conical hat and atop a pillar; on the right a praying figure?
Cf. Eisen and Kouchakji 1927, pl. 131, fig. 230, 533 (2 examples); Merlat 1949, nos 2–3, 721–2; Lafontaine-Dosogne 1967, nos 18–19, 158, pl. 46, figs 96–7; Sale catalogue 1989, no. 274, 76–7; Stiegemann 2001, nos 1.69.6-1.69.8, 185–7; Barag 2002, nos 378–9, 182, pl. 30; Arveiller-Dulong and Nenna 2011, no. 93, 61 (from Phoenicia).

Unpublished.

41. Glass pendant

4th century
Provenience: near Nazareth.
h. 27.5mm; w. 22.2mm; max d. of incuse 14mm; wt 3.1g
Colour: L*a*b* 40 5 23; Munsell 2Y 4/3
Bought from W.T.E. Tomlinson in 1892.
Reg. no. GR 1892,0317.94

Translucent amber disc with rolled rim and suspension loop. In high relief, a Medusa head.
Cf. Hampel 1905, 261, pl. 201, fig. 2 (from grave 43 of the cemetery at Czikó in Hungary); De Ridder 1909, no. 670, 285; Eisen and Kouchakji 1927, pl. 131; Gorov, Lazarov and Tchimbouleva 1967, no. 95 (from Burgas, Bulgaria); Cambi 1974, no. br.II.4 (from Solin, near Split); Zouhdi 1978, no. Id, 56, fig. 4a, which is incorrectly identified as a female bust (from Hauran, Syria); von Saldern 1980, no. 215, 32, pl. 22 (from Sardis); Sale catalogue 1989, no. 284, 76 and 78 (described as 'a severed head'!); Endrizzi and Marzatico 1997, no. 1205, 495 (from Bolzano-Gries, Italy); Barag 2001, no. 361, 179, pl. 29; Stern 2001, no. 214, 381; Barag 2002, no. LA-9, 312; Whitehouse 2003, no. 871. There is an unpublished example in the Glasmuseum in Wertheim (Haeverninck collection: THE 4357). For an example of a 'trilobitenperlen' with this motif, see: Sale catalogue 1989, no. 295, 79.
Gems: NY.MMA 1894, nos 104–10; Delatte and Derchain 1964, nos 309–10a; Berry 1968, no. 100; *AGDS* 1.3 no. 2705; *AGDS* 3 (Göttingen) no. 6086; *AGDS* 3 (Kassel) no. 112; *AGDS* 4 (Hannover) nos 1065–8; Philipp 1986, nos 38a, 39a and 43c; *AGWien* III nos 1646–7; Mastrocinque 2011, pl. 3a.

Iconography: There were multiple female bogies in Greek popular culture, Lamia the child-eater, for example, widely feared for her unlady-like behavior.[133] Most of these fantasy creatures did not achieve an iconographic identity, but Medusa was an exception. Greek mythographers gave her a role to play in the Perseus myth,[134] and as a consequence Greek patrons of the visual arts wanted to see her image.[135] Perseus cut off Medusa's head, and her face became petrified and monstrous, with snakes sprouting from her scalp. Medusa's severed head had a long history in Greek and Graeco-Roman iconography, and even in Late Antiquity it still functioned as an important apotropaic device.[136] One of the better-known, Late Antique *Stone Books*,[137] entitled *Damigeron-Evax* (a treatise on magic and the sympathetic properties of gemstones), advised engraving coral (though not a mineral) with the image of Medusa (or Hekate) as a protection against evil spirits.[138] For two reasons, this is an important testimony which may have a bearing on our glass pendants: 1. the text and the pendants are roughly contemporaneous (suggesting that Medusa's apotropaic powers were still an article of belief in Late Antiquity); 2. the text recommends carrying the engraved coral on one's person (as would have been done with the glass pendants).[139] (PCF)

Unpublished.

42. Glass pendant

4th century
Provenience: near Nazareth.
h. 24.2mm; w. 20mm; max d. of incuse 13mm; wt 2.5g
Colour: L*a*b*29 -2 -3; Munsell 8B 8/1
Bought from W.T.E. Tomlinson in 1892.
Reg. no. GR 1892,0317.95

Translucent dark blue disc with rolled rim and suspension loop. In high relief, a Medusa's head.
Cf. cat. no. 41.

Unpublished.

43. Glass pendant

4th century
Provenience: Greece.
h. 23.8mm; w. 17.4mm; max d. of incuse 14.5mm; wt 1.5g
Colour: L*a*b*30 4 4; Munsell 4YR 3/1
Given by the executors of Felix Slade in 1873.
Reg. no. GR 1873,0502.208

Opaque dark brown disc with rolled rim and suspension loop. In high relief, a Medusa's head.
Cf. cat. no. 41.

Unpublished.

Non-figural: animals

44. Glass pendant

4th century
Max d. 18mm; max d. of incuse approx 13.5mm; wt 1.2g
Colour: L*a*b*40 8 23; Munsell 9YR 4/4
Reg. no. PE 1983,1108.58

Translucent amber disc with rolled rim; suspension loop missing. A roaring lion with striated mane walking to left.
Cf. Cambi 1974, no. br.II 9, 143 and 150 (from Kaštel Sućurac, near Split); Zouhdi 1978, no.Ig, 59, fig. 2 (four examples, all from Hauran, Syria); Chéhab 1984, 438 and Chéhab 1986, pl. 44 (found in a sarcophagus at Tyre); Sale catalogue 1985, 276; Sale catalogue 1996, 43; Barag 2002, no.LA-33, 319.For similar depictions on bronze rings see: Rahmani 1985, nos 3 and 4, 170–1, pl. 42 (from Gush Halav, Israel); Braun, Dauphin and Hadas 1994, 112, fig. 5 (from Sajur, Israel).
Gems: For the general type, see Michel 2004, s.v. löwe, 306–7 (with numerous examples and bibliography).
Coins: see **pls 8–9**.

Iconography: Lion pendants are by far the most popular type found in most collections of Late Antique glass pendants. Here cat. nos 44–71, 76 show profiles of single lions, striding (or pouncing). In all cases (with the possible exception of cat. no. 76) the sex of the animal is male, however in several examples the mane (the marker of gender differentiation) is barely indicated. The iconographic context for cat. nos 44–71 is clearly astrology. In 12 examples (cat. nos 46–7, 51–4, 57, 59–63) there is a six-pointed star in the field over the haunches or head of the beast. The single star is shorthand for multiple stars constitutive of the Leo constellation; the ancient literature of Catasterism (Constellations) attributed various numbers to the sign of Leo.[140] In 17 examples (cat. nos 46–7, 54–6, 58–63, 66–71) there is a crescent moon (associated either with waxing [27 July to 7 August] or waning [second half of August]).[141] And in six examples (cat. nos 66–71) there is an annular mark within the crescent, probably to be identified as the sun. The positioning of the star and crescent moon is always in the upper field and there are two designs: either the crescent is open to the top with the star contained within it, as seemingly happens exclusively when the lion is depicted with a frontal head, or the symbols are shown side by side, with the star normally at left and the crescent *always* open to the left. In Egyptian, Greek and Roman astrology Leo was a solar symbol.[142] Writing in a time-frame relevant to our glass pendants, Proklos calls Leo a 'heliac creature' (ἡλιακόνξῶν).[143]

Three iconographic types are represented here:

1. Cat. nos 44–57, 76: profile left, Leo in the western sky encroaching on Cancer (not shown);

2. Cat. nos 58–71: profile right: Leo in the eastern sky encroaching on Virgo (not shown);

3. Cat. nos 66–71, profile right, but with the head facing front.

For all three, the iconographic prototypes are numismatic. For types 1 and 2, coins of Antiochos I 'Soter' (324–261 BC), found on the western terrace at Nemrud Dağı, 55km. west of Diyarbakir in southeastern Turkey, constitute the distant iconographic model.[144] For type 3, the prototype is to be found in the equally remote Hellenistic coinage of Alexander.[145] The examples of Leo the lion given on our glass pendants are debased (in some examples, grossly) by comparison with their Hellenistic prototypes.

As for the symbolic associations that wearers of our lion pendants may have constructed in their mind's eye, it is possible that astrological meanings were contemplated in some instances. But there were many other leonine associations in the popular mind. One of the persistent meanings associated with lion imagery in all periods of antiquity was power, the lion's dominion over all living creatures, read in two ways: the power to destroy (the lion as predator: cat. nos 72–5)[146] and the power to protect or guard. We know that glass pendants were strung on a cord or chain and worn on the body as pendants, in some cases as necklaces; wearers will have opined it was a good idea to have lions protecting their necks. (PCF)

Unpublished.

45. Glass pendant

4th century
h. 22.5mm; w. 19mm; max d. of incuse 15mm; wt 1.5g
Colour: L*a*b*38 6 19; Munsell 1Y 4/3
Reg. no. PE 1983,1108.57

Translucent brown disc with rolled rim and suspension loop. A roaring lion with striated mane walking to left.
Cf. cat. no. 44.

Unpublished.

46. Glass pendant

4th century
Provenience: Bêt Jibrûn, near Hebron.
h. 23.5mm; w. 20.5mm; max d. of incuse 14.5mm; wt 2.2g
Colour: L*a*b* 45 5 24; Munsell 3Y 5/4
Given by Mrs H.H. Way in 1908.
Reg. no. ANE 1908,0615.17 (running no. 102732)

Translucent amber (not clean) disc with rolled rim and suspension loop. A roaring lion with striated mane walking to left; in the field above, a star and crescent moon. Both this and the following example were possibly stamped with the same die.
Cf. Wulff 1909, no. 1159; Zahn 1929, no. 373, 116, pl. 20; Iliffe 1934, no. 1, 11, pl. 8.4 (from Tarshihā, Israel); Kukai 1977, no. 59, pl. 59 (from Gilan province, Iran); Sale catalogue 1989, no. 286, 76 and 79; Porat 1997, 84, fig. 3.6 (from Karmiel, Israel); Gorin-Rosen 1998, back cover; Barag 2002, no. 389, 183, pl. 30; Whitehouse 2003, no. 897; Wamser 2004, no. 597, 319.

Unpublished.

47. Glass pendant

4th century
Provenience: Bêt Jibrûn, near Hebron.
h. 25mm; w. 23mm; max d. of incuse 14.5mm; wt 3.1g
Colour: L*a*b*38 5 13; Munsell 1Y 4/4
Given by Mrs H.H. Way in 1908.
Reg. no. ANE 1908,0615.15 (running no. 102730)

Translucent amber disc with rolled rim and suspension loop. A roaring lion with striated mane walking to left; in the field above, a star and crescent moon.
Cf. cat. no. 46.

Unpublished.

48. Glass pendant

4th century
Max d. 21.2mm; max d. of incuse 15mm; wt 1.7g
Colour: L*a*b*41 6 24; Munsell 2Y 4/3
Reg. no. PE 1983,1108.59

Translucent amber disc with rolled rim; suspension loop missing. A lion with striated mane pouncing to left.
Cf. Cesnola 1903, no. 10, pl. 18 (from Idalium, Cyprus); De Ridder 1909, no. 677, 287; Gentili 1967, 136–7, fig. 4.1 (from Sicily); Chéhab 1984, 67 and Chéhab 1986, pl. 44 (from a 4th-century loculus at Tyre); Sale catalogue 1996, 43; Gesztelyi 2001a, no. 4, 234, fig. 4, but also with a crescent above its back (from Asia Minor); Whitehouse 2003, no. 887; Sale catalogue 2005, no. 1296; there is also an unpublished example in the Glasmuseum in Wertheim (Haeverninck collection: THE 3382); Giovannini 2010, 133, no. 4, fig. 2, 141 (from Trieste), but pouncing to right; Arveiller-Dulong and Nenna 2011, no. 71 (from Phoenicia) and nos 68–70, 55 (from Phoenicia), but pouncing to right and all probably stamped with the same die.

Unpublished.

49. Glass pendant

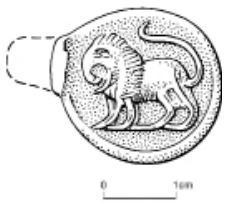
4th century
h. 21.1mm; w. 18.7mm; max d. of incuse approx 15mm; wt 1.7g
Colour: L*a*b*38 7 18; Munsell 1Y 4/3
Bought from the Rev. G.J. Chester in 1875.
Reg. no. GR 1875,0522,2

Translucent amber disc with rolled rim and incomplete suspension loop. A lion with striated mane pouncing to left.
Cf. cat. no. 48.

Unpublished.

50. Glass pendant

4th century
Max d. 18.8mm; max d. of incuse approx 15mm; wt 1.2g
Colour: L*a*b*50 7 33; Munsell 1Y 4/5
Bought from the Rev. G.J. Chester in 1875.
Reg. no. GR 1875,0522.1



Translucent amber disc with very slight rim; suspension loop missing. A lion walking to left.
No exact parallel, the closest being: Cesnola 1903, no. 8, pl. 18 (from Idalium, Cyprus); Crowfoot *et al.* 1957, 398, pl. 26.4 (from Samaria-Sebaste); Gentili 1967, 36, fig. 4.1 (from Piazza Armerina, Sicily); Sagi 1981, fig. 14 (from grave 56 of the cemetery at Keszthely-Dobogó, Hungary); Barag 2001, no. 393, 183, pl. 30; Sale catalogue 2006, no. 560. For a lion walking to right: Baldini Lippolis 1999, no. 1, 150 (from Bosra, Syria); Gasparri 2009, no. 127.9, 287, fig. 14. Like the next example and cat. no. 84, this is a rare example of a pendant where the image has been struck at a right angle to the loop. This divergence from the norm in the orientation of the image is, unlike some magical gems for instance, probably not of any significance.

Unpublished.

51. Glass pendant

4th century
h. 29.8mm; w. 22mm; max d. of incuse approx 18mm; wt 3.4g
Colour: L*a*b*34 0 -9; Munsell 7PB 3/2
Coated
Bought from the Rev. G.J. Chester in 1883.

Reg. no. GR 1883,0621.12

Translucent dark blue disc with rolled rim and suspension loop; areas of iridescence. A roaring lion walking to left; above it, a star. The die has been struck off axis.
Cf. De Ridder 1909, nos 679 and 680, 287, pl. 32. This pendant can also be compared with cat. no. 84, which shows a horse in similar orientation. In addition, they also share the same Munsell colour and slightly 'twisted' suspension loops suggesting that they might come from the same workshop.
Gems: *AGDS* 2 no. 252.

Unpublished.

52. Glass pendant

4th century
Max d. 19.1mm; max d. of incuse 15mm; wt 1.3g
Colour: L*a*b* 35 9 17; Munsell 9YR 3/3
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,06011.89

Translucent amber disc with rolled rim; suspension loop missing. A lion walking to left; in the field above, a star. Both this and the following example may have been stamped with the same die.
Cf. Richmond 1932, 53, pl. 33, fig. 4 (from a tomb in Nazareth); Carter 2003, 172, fig. 11.31 misidentified as an exagium (from Chersonesos); Sale catalogue 2006, no. 560, pl. XLI; Eger and Hamoud 2011, 76, fig. 11b (from a necropolis in Darayya near Damascus); Wentzel 1962, 313–15, 320, pl. 14, but the lion to right.
Coins: Carson 1980b, no. 1626, 97 (Leo, AD 457–74); Grierson and Mays 1992, 164 (Class 3), pl. 22:580–01 (Leo).

Unpublished.

53. Glass pendant

4th century
Provenience: Jerusalem.
h. 19mm; max d. of incuse 15mm; wt 1.1g
Colour: L*a*b* 35 7 17; Munsell 1Y 3/3
Bought from the Rev. G.J. Chester in 1867.
Reg. no. ANE 1867,0915.110 (running no. 102772)

Translucent amber disc with rolled rim; suspension loop broken. A lion walking to left; in the field above, a star.

Cf. cat. no. 52.

Unpublished.

54. Glass pendant

4th century
Provenience: Bêt Jibrûn, near Hebron.
h. 19.5mm; w. 19.3mm; max d. of incuse 14mm; wt 1.0g
Colour: L*a*b* 47 4 12; Munsell 10YR 4/3
Coated
Given by Mrs H.H. Way in 1908.
Reg. no. ANE 1908,0615.18 (running no. 102733)

Translucent amber disc with rolled rim; suspension loop missing. A lion walking to left; above its back, a crescent moon and star (?).
Cf. Cesnola 1903, no. 6, pl. 18 (from Idalium, Cyprus); Beck 1927, 21, fig. 19, B.1.a; Cambi 1974, no. br.II 3, 142 and 149 (from Solin, near Split). Baldini Lippolis 1999, no. 2, 150 (from Bosra, Syria), but with a star only; possibly Mandruzzato 2008, no. 144, 77 (from Aquileia); Arveiller-Dulong and Nenna 2011, no. 74, 56 (from Cyprus). For a bracelet fragment with a similar design see: Spaer 1988, 59, fig. 10.

Unpublished.

55. Glass pendant

4th century
Provenience: Egypt.
Max d. 22.1mm; max d. of incuse approx 14mm; wt 2.5g
Colour: L*a*b*31 9 14; Munsell 7YR 3/2
Given by the executors of Felix Slade in 1871.
Reg. no. GR 1871,0616.34

Translucent amber disc with rolled rim; suspension loop missing. A lion walking to left; above its back, a crescent moon. Both this and the following example may have been stamped with the same die.
Cf. Le Lasseur 1922, 21, fig. 13c (from Tyre); Bagatti and Milik 1958, 155, pl. 42, fig. 128.4 (from Jerusalem); Mandruzzato 2008, no. 142, 77 (from Aquileia).
Gems: *AGDS* 1.3 no. 2834; Bizzarri 1987, no. 264, 132.

Unpublished.

56. Glass pendant

4th century
Max d. 21.8mm; max d. of incuse 15mm; wt 2.3g
Colour: L*a*b* 32 4 7; Munsell 8YR 3/1
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.8[c]

Translucent amber disc with rolled rim; suspension loop missing. A lion walking to left; above its back, a crescent moon.
Cf. cat. no. 55.

Unpublished.

57. Glass pendant

4th century
h. 20mm; w. 16.8mm; max d. of incuse approx. 11.5mm; wt 1.0g
Colour: L*a*b* 45 6 20; Munsell 1Y 4/3
Reg. no. PE 1983,1108.55

Translucent yellow disc with rolled rim and suspension loop. A lion walking to left; in front of it, a star.

Unpublished.

58. Glass pendant

4th century
Max d. 17.8mm; max d. of incuse 14mm; wt 1.4g
Colour: L*a*b*48 4 16; Munsell 1Y 4/2
Coated
Reg. no. PE 1983,1108.56

Translucent amber disc with rolled rim; suspension loop missing; heavily iridescent. A roaring lion with striated mane walking to right; in the field above, a crescent moon.
Cf. Froehner 1903, no. 865, 124, pl. 151.43, and Baldini Lippolis 1999, no. 1, 150 (from Bosra, Syria), but both without the crescent moon; Sale catalogue 2005, no. 1297; Mandruzzato 2008, no. 143, 77 (from Aquileia).
Gems: Henig 1978, App. 174.

Unpublished.

59. Glass pendant

4th century
Max d. 18.1mm; max d. of incuse approx 13mm; wt 1.3g
Colour: L*a*b*37 -12 16; Munsell 9B 3/5
Given by the executors of Felix Slade in 1872.
Reg. no. GR 72,0726.33

Translucent turquoise disc with rolled rim; suspension loop missing. A lion walking to right; in the field above, a star and crescent moon.
Cf. Froehner 1903, no. 865, 124, pl. 151.42; Orsi 1912, 209, fig. 40b (from Acrae, Sicily); Iliffe 1934, nos 1–5, 12, pl. 8.2 (from Tarshihā, Israel); Neuberg 1949, pl. 30, fig. 103; Cambi 1974, nos br.II 1, 2, 5, 13 and 16, 142–4 and 149–50, (all from Solin, near Split); Forien de Rochesnard 1978, 65; Chéhab 1985, 680 and Chéhab 1986, pl. 45 (found in a sarcophagus at Tyre with a coin of Claudius Albinus [AD 194–5]); Sale catalogue 1985, 276; Sale catalogue 1989, no. 285, 76 and 78; Barag 2001, nos 385–6, 182, pl. 30; Gesztelyi 2001a, nos 1 and 3 (from Baláca and Ságvár), 234 and figs 1 and 3; Gesztelyi 2001b, 109–11, fig. 4; Barag 2002, no. LA-32, 182, pl. 30; Papanikola-Bakirtzi 2002, no. 756 (from a 4th-century tomb in the eastern cemetery in Thessaloniki), which is republished in Adam-Veleni 2010, no. 271, 297; Arveiller-Dulong and Nenna 2011, no. 78, 57 (from Cyprus); there is also an unpublished example from Amman in the Glasmuseum in Wertheim (Haeverninck collection: THE 3786). For a lion with striated mane walking to right, see: Wulff 1909, no. 1160; Almeida 1965, pl. III, no. 1 (from *Igaeditania* [mod. Idanha-a-Velha], Portugal); Boussac and Starakis 1983, no. 66, fig. 65, 480, and Whitehouse 2003, nos 888–90, for similar examples but without the star and crescent. For a black paste intaglio with a lion with striated mane walking to right, with a star above and a Hebrew inscription on the reverse, see: Hamburger 1968, no. 115, 33, pl. V (from Caesarea Maritima). See Overbeck 1971, 134, pl. 15.8 for a similar pendant, but the crescent and star replaced by a cross; Peleg 1991, no. 13, 142, figs. 12.2 and 13.6, and 146 for an example with only a star in the field (from Lohamei Hagetat'ot, Israel); Spaer 1988, fig. 10 for a glass bracelet fragment stamped with a similar design, but the lion moving to left.

Coins: Carson 1980a, no. 795, 96 (antonianus of Philip I, AD 244–9), but without the star and crescent.

Unpublished.

60. Glass pendant

4th century
h. 25mm; w. 21.8mm; max d. of incuse 15.5mm; wt 2.2g
Colour: L*a*b*31 7 9; Munsell 6YR 3/3
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.88

Translucent brown disc with rolled rim and suspension loop. A lion walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 59.

Unpublished.

61. Glass pendant

4th century
Provenience: Egypt.
h. 24.7mm; w. 20.5mm; max d. of incuse 16.5mm; wt 1.7g
Colour: L*a*b*43 13 33; Munsell 1Y 4/8
Bought from the Rev. G.J. Chester in 1874.
Reg. no. GR 1874,0716.7

Translucent brown disc with rolled rim and suspension loop.A roaring lion walking to right; in the field above, a star and crescent moon.
Cf. Arveiller-Dulong and Nenna 2011, no. 81, 58, but struck off axis; Martiniani-Reber 2011, no. 163, 232. The unusual arrangement of the star and crescent, where the star is placed inside the upturned crescent, is mirrored on cat. nos 66–71.

Unpublished.

62. Glass pendant

4th century
Provenience: Cyprus.
h. 25.9mm; w. 18.9mm; max d. of incuse 13.5mm; wt 1.9g
Colour: L*a*b* 37 9 18; Munsell 8YR 3/4
From the Cesnola Collection. Given by the executors of Felix Slade in 1871.
Reg. no. GR 1871,0123.9

Translucent brown disc with rolled rim and suspension loop. A roaring lion walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 59.

Unpublished.

63. Glass pendant

4th century
Max d. 20mm; max d. of incuse 14.3mm; wt 1.8g
Colour: L*a*b* 26 2 -8; Munsell 7PB 3/2
Roper Collection. Acquired in 1980.
Reg. no. PE 1980,0611.87

Translucent blue disc with rolled rim; suspension loop missing. A roaring lion pouncing to right; in the field above, a crescent moon; in front of it, a star.

Unpublished.

64. Glass pendant

4th century
Max d. 19.9mm; max d. of incuse approx 13mm; wt 1.9g
Colour: L*a*b* 41 7 22; Munsell 1Y 4/4
Reg. no. GR 1976,0916.2

Translucent amber disc with rolled rim; suspension loop missing. Within a circle, a lion pouncing to right.
Cf. Noll 1963, 68–9, pl. 11 (from Salorno, Italy); Whitehouse 2003, no. 886; Mandruzzato 2008, nos 145–6, 77 (from Aquileia); Martiniani-Reber 2011, nos 167–8, 234 (no. 168 possibly from the same die as the above); Forien de Rochesnard 1978, no. C5, 73–4, for a supposed weight with a very similar lion.

Unpublished.

65. Glass pendant

4th century
Provenience: Egypt.
h. 21.6mm; w. 20.5mm; max d. of incuse 15mm; wt 1.7g
Colour: L*a*b*35 8 17; Munsell 8YR 3/2
Bought from the Rev. G.J. Chester in 1883.
Reg. no. GR 1883,0621.14

Translucent amber disc with rolled rim and most of the suspension loop missing. A lion walking to right; in the field above, a retrograde inscription: EIC ΘEOC (Εἷς θεός '[there is] one God').
Cf. Cambi 1974, no. br.II.14, 150, pl. 1.4 (from Solin, near Split); Bomford 1976, no. 81, 24; Zouhdi 1978, no. IIg, 62 (from Khisfin, Syria); Barag 2001, no. 383, 182, pl. 30; Barag 2002, no. LA-27, 318; Whitehouse 2003, nos 891–3; Martiniani-Reber 2011, no. 165, 233.There is an unpublished necklace in the C.S. collection in Munich with an identical pendant (no. 2388). For a pendant just inscribed EIC ΘEOC see: Henig 1994, no. 549, 254–5 (from Beth Jibrui, near Hebron).

Unpublished.

66. Glass pendant

4th century
Provenience: Beirut.
h. 26.6mm; w. 21mm; max d. of incuse 13.5mm; wt 2.1g
Colour: L*a*b* 41 -3 13; Munsell 1GY 5/3
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.9

Translucent green disc with rolled rim and suspension loop; traces of iridescence. A lion with frontal head walking to right; in the field above, a star and crescent moon. Both this and the following two examples were possibly stamped with the same die.
Cf. De Ridder 1909, no. 678, 287 (from Tortosa, Syria); Eisen and Kouchakji 1927, pl. 131 (three examples); Spartz 1967, no. 160, pl. 38; Zouhdi 1978, no. If, 58, fig. 2 (from Syria); Boosen 1984, no. 192, 92; Zwierlein-Diehl 1991, no. 2506, 227, pl. 159; Baldini Lippolis 1999, no. 1, 143 (from Syria); there is also an unpublished example from Amman in the Glasmuseum in Wertheim (Haeverninck collection: THE 3787), and in the C.S.

collection in Munich there are nine pendants, all probably from the same necklace, of which seven have the design described above (nos 1193A-H,J); Barag 2001, no. 391, 183, pl. 30, but the lion to left; Stern 2001, nos 211 and 212 (lion to left), 378–9; Barag 2002, no. LA-31, 319; Whitehouse 2003, nos 894 and 898 (lion to left in both cases) and 895 and 899; Arveiller-Dulong and Nenna 2011, no. 82, 58, and nos 72, 73 and 75, 56 (one from Phoenicia, one from Syria or Egypt), but all to left. See also, Israeli 2003, no. 394, 295 for a miniature jar (dated 4th to 5th century) with three stamped impressions of a not dissimilar lion (but moving to left) on the vessel's body.

Unpublished.

67. Glass pendant

4th century
Provenience: Beirut.
h. 25.2mm; w. 17.8mm; max d. of incuse approx 13mm; wt 1.8g
Colour: L*a*b*43 -3 15; Munsell 1GY 5/3
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.9

Translucent green disc with slightly rolled rim and suspension loop. A lion with frontal head walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 66.

Unpublished.

68. Glass pendant

4th century
Provenience: Beirut.
h. 25mm; w. 16.8mm; max d. of incuse 13.5mm; wt 1.7g
Colour: L*a*b*38 -2 19; Munsell 10Y 4/3
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.9

Translucent green disc with rolled rim and suspension loop. A lion with frontal head walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 66.

Unpublished.

69. Glass pendant

4th century
Provenience: Egypt.
h. 27.1mm; w. 19.4mm; max d. of incuse approx 14mm; wt 2.5g
Colour: L*a*b*24 1 -5; Munsell 9PB 2/1
Bought from the Rev. G.J. Chester in 1874.
Reg. no. GR 1874,0716.6

Translucent blue disc with rolled rim and suspension loop. A lion with frontal head walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 66.

Published: Tatton-Brown 1995, 40, fig. 9c.

70. Glass pendant

4th century
Provenience: Beirut.
h. 22.1mm; w. 15.5mm; max d. of incuse approx 13mm; wt 1.3g
Colour: L*a*b* 26 2 13; Munsell 7PB 3/3
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.9

Translucent blue disc with slightly rolled rim and suspension loop. A lion with frontal head walking to right; in the field above, a star and crescent moon. Both this and the following example may have been stamped with the same die.
Cf. cat. no. 66.

Published: Tatton-Brown 1995, 40, fig. 9a.

71. Glass pendant

4th century
Provenience: Beirut.
h. 22mm; w. 14.3mm; max d. of incuse approx 13mm; wt 1.3g
Colour: L*a*b*29 1 11; Munsell 6PB 3/4

Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.9

Translucent dark blue disc with slightly rolled rim and suspension loop. A lion with frontal head walking to right; in the field above, a star and crescent moon.
Cf. cat. no. 66.

Unpublished.

72. Glass pendant

4th century
hH. 21.1mm; w. 18mm; max d. of incuse 12.5mm; wt 1.8g
Colour: L*a*b*29 6 8; Munsell 7YR 3/1
Reg. no. GR 1976,0916.1

Translucent amber disc with rolled rim and suspension loop. A roaring lion to left resting its forelegs on the back of a recumbent wild goat with backward-turned head.
Cf. Zwierlein-Diehl 1991, nos 2504–05, 226–7, pl. 159; Mandruzzato 2008, no. 141, 77 (from Aquileia).
Gems: *AGDS* 1.3 no. 2828; *AGDS* 4 (Hamburg) no. 71; *AGWien* III no. 1793; Weiller 1980, no. 104, 236–7, pl. 9.

Unpublished.

73. Glass pendant

4th century
h. 23.9mm; w. 20mm; max d. of incuse approx 12.5mm; wt 1.9g
Colour: L*a*b*36 10 20; Munsell YR 3/5
Reg. no. PE 1983,1108.54

Translucent amber disc with rolled rim and suspension loop. A lion to left resting its forelegs on the back of a recumbent wild goat with backward-turned head.
Cf. cat. no. 72.

Unpublished.

74. Glass pendant

4th century
Provenience: Egypt.
h. 17.2mm; w. 13.4mm; wt 0.8g
Colour: L*a*b* 32 1 -1; Munsell 9PB 3/0
Given by the executors of Felix Slade in 1871.
Reg. no. GR 1871,0616.33

Translucent blue disc with almost flattened rim and suspension loop. A lion rearing to right, resting its forelegs on the back of an indistinguishable supine animal.
Cf. Griefenhagen 1975, no. 4, 27, pl. 21.1 (from Olbia, Sardinia); Wamser 2004, no. 600, 319.

Unpublished.

75. Glass pendant

4th century
Provenience: Bêt Jibrûn, near Hebron.
h. 24.5mm; w. 20mm; max d. of incuse 13mm; wt 2.1g
Colour: L*a*b* 37 5 19; Munsell 3Y 4/4
Given by Mrs H.H. Way in 1908.
Reg. no. ANE 1908,0615.16 (running no. 102731)

Translucent olive green disc with rolled rim and suspension loop. A lion rearing to right and resting its forelegs on the rump of a wild goat; in the field above, a palm-branch.
Cf. cat. no. 72 for the general type.

Unpublished.

76. Glass pendant

4th century
Provenience: Cyprus.
h. 25.2mm; w. 20.2mm; max d. of incuse approx 12.5mm; wt 2.5g
Colour: L*a*b* 44 5 15; Munsell 1Y 4/2
Coated
From the Cesnola Collection. Given by the executors of Felix Slade in 1871.
Reg. no. GR 1871,0123.8

Translucent discoloured green disc with rolled rim and suspension loop. A lion (?) walking to left.

Unpublished.

77. Glass pendant

4th century
Provenience: Egypt.
Max d. 18mm; max d. of incuse 14.5mm; wt 1.3g
Colour: L*a*b*39 7 23; Munsell 10YR 3/3
Bought from the Rev. G.J. Chester in 1876.
Reg. no. GR 1876,0527.19

Translucent amber disc with rolled rim; suspension loop missing. An actor's mask.
Cf. Middleton 1991, no. 16, 156, fig. App. 16; *AGWien* III no. 2507, 227, pl. 159. For spacer beads with this motif see: Haeverninck 1973, pl. 2: 1, 6; *AGWien* III nos 2517–8; Arveiller-Dulong and Nenna 2011, nos 59–62.
Gems: *AGDS* 2 no. 56.

Unpublished.

78. Glass pendant

4th century
h. 20mm; w. 15mm; wt 2.0g
Colour: L*a*b*29 -1 -5; Munsell 5PB 2/1
Bought from the Rev. G.J. Chester in 1883.
Reg. no. GR 1883,0621.13

Translucent blue disc with suspension loop. A quadruped with humped back and protruding neck, probably a frog (or tortoise).
Cf. De Ridder 1909, nos 681–3, 288, pl. 32; Eisen and Kouchakji 1927, pl. 131, fig. 230, 533; Zahn 1929, no. 373, 116, pl. 20; Iliffe 1934, no. 6, 12, pl. 8.3 (from Tarshihā, Israel); Spartz 1967, no. 160d, pl. 38; Cambi 1974, no. br.II 11, 143 and 150 (from Solin, near Split); Bomford 1976, no. 81, 24; Sale catalogue 1978, no. 18 (also inscribed ZOH); Zouhdi 1978, no. Ie, 56 (from Salamien, near Hama, Syria); Preda 1980, no. 351.1, 113, pl. 90 (from grave 351 of the cemetery in Callatis, Romania); Sagi 1981, no. 4b, 30, fig. 15 (from Keszthely-Dobogó, Hungary, and also inscribed ZOHN; Boosen 1984, no. 192, 92; Kozloff *et al.* 1986, no. II, 97, 98; Şovan 1987, fig. 2, no. 8 which is republished in: Exhibition catalogue 1994, no. I. 31g, 105 (from a cemetery at Mihălăşeni, Romania); Sale catalogue 1989, no. 281, 76 and 78; Barag 2001, nos 395–9, 183–4, pl. 31; Barag 2002, nos LA-39 – LA-40 and LA-41 (but inscribed ZOHN); Whitehouse 2003, nos 881–4; Hirschfeld and Peleg 2006, 201–8 (from Tiberias); Sale catalogue 2006, no. 564; Warmenbol 2006, no. 122, 292; Giovannini 2010, no. 4, 133, fig. 4, 141 (from Trieste, but inscribed ZOHN); Arveiller-Dulong and Nenna 2011, nos 84–7, 59 (one from Syria, two from Phoenicia). There is also an unpublished example in the C.S. collection in Munich (no. 0736).
Gems: *AGDS* 1.3 no. 2428; Michel 2001, no. 98 (winged frog); Michel 2004, 67, n. 343; Gesamtregister: Frosch.

Iconography: The long front legs suggest a frog (βάτραχος-rana) or toad, not a tortoise-turtle. Frogs appear (alongside salamanders and snakes) on bronze Sabazios hands associated primarily with Hellenistic and Graeco-Asiatic cults in Turkey (Phrygia), the north Aegean (Thrace) and Syria. As material types, the closest parallels to the pendant frogs are examples found of engraved gemstones which functioned as apotropaic amulets.[147] An Egyptian theriomorph shows a frog-headed goddess, Hiquit, Heka or Hek, personifying resurrection, and in the popular culture of Late Antiquity, frogs signified fertility, generation, long life, protection from harm.

Pliny classified frogs (*ranae*) by habitat (sea, wetlands, land , inland waterways, trees). He summarises his views on their therapeutical (medical/magical) value at *Nat. Hist.* 32.49: '(Concerning frogs) magicians add other details, which if they are true, (mean that) frogs are valued as more useful to human life than are laws' (*addunt etiamnum alia Magi, quae si vera sint, multo utiliores vitae existumentur ranae quam leges*…). Maecenas must have owned an intaglio cut engraved gemstone marked with a frog and used as a signet; he evidently stamped notices of tribute (or tax) monies due to the state and in this way Maecenas' frog evoked great fear among Octavian's subjects; *Nat. Hist.* 37.10. (PCF)

Unpublished.

79. Glass pendant

4th century
h. 19.4mm; w. 14.2mm; max d. of incuse approx. 10mm; wt 1.1g
Colour: L*a*b*32 -3 -2; Munsell 7B 3/1
Bought from the Rev. G.J. Chester in 1884.
Reg. no. GR 1884,0509.5

Translucent blue disc with slightly rolled rim and suspension loop. A quadruped with humped back and protruding neck, probably a frog (or tortoise).
Cf. cat. no. 78.

Unpublished.

80. Glass pendant

4th century
h. 23.8mm; w. 18mm; max d. of incuse 12mm; wt 2.4g
Colour: L*a*b*34 -6 2; Munsell 2BG 3/2
Bought from the Rev. G.J. Chester in 1884.
Reg. no. GR 1884,0509.6

Translucent green disc with rolled rim and suspension loop. A scorpion.
Cf. Fremersdorf 1975, no. 889, 97, pl. 58; Sabrosa 1996, 295, figs. 7, 21e and 299 (from tomb no. 26 in the necropolis of Porto dos Cacos, near Alcochete, Portugal); Mandruzzato 2008, no. 147, 78 (from Aquileia).
Gems: *AGDS* 1.3 nos 2692b and 3425; *AGDS* 3 (Kassel) no. 191; *AGDS* 4 (Hannover) nos 1297 and 1717; Sena Chiesa 1978, nos 149–50; Philipp 1986, no. 122c; Krug 1980, Register, s.v.; *AGWien* III nos 1994–9; Henig 1994, no. 381; Michel 2001, nos 342–4; Michel 2004, 51. Skorpion, 331–2.

Iconography: Next to the beetle, this venomous arachnid was the most frequently portrayed insect in ancient pictorial art. Along the body of the insect there are three pairs of lateral appendages; its tail is punctuated with tubers (nodules, knots) and at the tip of the tail is the stinger – in antiquity the tail was construed as a quintessential marker of pain and death.[148] Asiatic and African scorpions release potentially lethal neurotoxins into the bodies of their victims; the sting of European scorpions, now and in antiquity, is relatively less potent. Scorpions are nocturnal hunters, and their daytime habitat is ground debris, subsurface crevices and protected openings beneath rocks and bark – in antiquity they were proverbial for lurking beneath stones (Aristophanes, *Thesmophoriazusae*, 529). The ancient literary and documentary sources that discuss the insect are extensive.[149] In broad terms the ancient discussion of the creature fell under two rubrics: science and religion. Medicine, pharmacology and toxicology make up part of the discourse; astrology, divination and magic[150] make up the other. Metaphorical applications were popular among Early Christians – the best-known example is Luke 10:19 where Jesus gives his disciples the authority to 'tread on scorpions', which signifies killing *daimones*, evil spirits acting as agents of the devil.

Given its dark habitat and its repugnant behavior (cannibalising its own offspring), ancients viewed scorpions as signifiers of chthonic evil, but in a common mythographic inversion of nature, Greeks (prompted by an Egyptian precedent) elevated the order *Scorpionida* from chthonic to heavenly, from noxious to prophylactic. Scorpio killed Orion, and to reward him, Zeus elevated this death-dealing critter to the heavens; Scorpio became the well-known 8th sign of the Zodiac (*c.* 24 October to *c.* 21 November).[151] Scorpio ascendant heralded relief from summer's unremitting rays and the coming of autumn's cooling breezes. This is the ideological background of our glass pendant, of course rendered here within the highly-diluted stew of Late-Antique popular culture in its Levantine form. Iconographic parallels on engraved Late-Antique gemstones (especially green malachite, nephrite and feldspar) and on jewellery are multiple – the scorpion was a sign that persons wanted to wear and display close to the body as an apotropaic shield.[152] (PCF)

Unpublished.

81. Glass pendant

4th century
Provenience: Beirut.
h. 25mm; w. 17.2mm; max d. of incuse 12.5mm; wt 1.6g
Colour: L*a*b*28 -5 4; Munsell 0GY 3/1
Bought from the Rev. G.J. Chester in 1887.
Reg. no. GR 1887,0706.10

Translucent green disc with rolled rim and suspension loop. A wild goat walking to left; behind it, a tree. The die has been struck off axis.
Cf. Eisen and Kouchakji 1927, pl. 131, fig. 230, 533; Sale catalogue 1989, no. 289, 78; Barag 2001, no. 400, 184, pl. 30; Barag 2002, no. LA-37, 320; Whitehouse 2003, no. 958.

Iconography: The long-horned animal exhibited in the pendant is presumably the alpine goat (paseng, bezoar goat, Gk: αἴξ ἄγριος, Lat: *capra aegragus*, the progenitor of the domestic goat, which was important to the ancient economy (for its flesh, milk and skin).[153] In the Greek world the wild goat was endowed with a mythological pedigree (on Cretan Dikte, the nymph Amaltheia [metamorphosed into a she-goat] nursed the infant Zeus, and it was elevated to a heavenly status (Capricorn, the 10th sign of the Zodiac). In short the wild goat enjoyed lofty associations, not just in nature but also in literature and culture. The symbolic associations that the image of the wild goat might have called to mind in Late Antiquity are matters for speculation. (PCF)

Unpublished.

82. Glass pendant

4th century
Max d. 19.3mm; max d. of incuse 14.5mm; wt 1.3g
Colour: L*a*b*37 7 18; Munsell 1Y 4/4
Bought from Mons. A. Sambon in 1869.
Reg. no. GR 1869,0709.98

Translucent amber disc with rolled rim; suspension loop missing. A ram walking to left with, in front of it, on the ground, a plant (possibly a palm frond?); in the field above the animal's back, an eight-pointed star and a crescent.
Cf. Bomford 1976, no. 81, 24; Barag 2002, no. LA-36, 320; possibly Carter 2003, 172, fig. 11.31 (from Chersonesos), where it is incorrectly identified as an exagium (glass weight); Giovannini 2010, no. 4, 133, fig. 3, 141 (from Trieste: two examples).

Iconography: Due to the presence of a star (eight-pointed in cat. no. 82, six-pointed (?) in cat. no. 83) alongside a crescent moon, the identification of the ram (Gk: κριός; Lat: *aries* as the ancient constellation of 17 (or 13 + 5) stars is secure. Aries was one of the 48 constellations listed by Ptolemy, and in the West, within the tropical Zodiac, it ranked as the first sign (♈), between Pisces and Taurus, corresponding to *c.* 21 March to 19 April, marking the beginning of the Spring season. Hellenised Aries was an *interpretatio graeca* of Egyptian Amon.[154] Greeks gave Aries a mythological pedigree – at Colchis Phrixinus sheared the animal and sacrificed it to Zeus who elevated Aries to the heavens. The famous fleece remained on earth where it was retrieved by Jason. In a very general sense, Aries signified fertility, prosperity and wealth – what this image meant to the Late-Antique wearers of our glass pendants we cannot know.

Unpublished.

83. Glass pendant

4th century
h. 21mm; w. 19mm; max d. of incuse 14.5mm; wt 1.6g
Colour: L*a*b* 35 4 15; Munsell 1Y3/3
Reg. no. PE 1983,1108.60

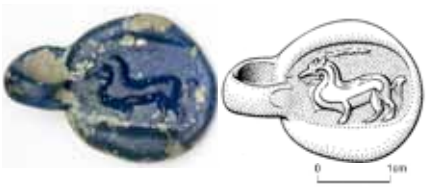
Translucent amber disc with rolled rim and incomplete suspension loop. A ram walking to left with, in front of it, on the ground, a plant (possibly a palm frond?); in the field

above the animal's back, a rather blurred six-pointed (?) star and a crescent.
Cf. cat. no. 82.

Unpublished.

84. Glass pendant

4th century
h. 29.3mm; w. 21mm; max d. of incuse approx 17mm; wt 3.2g
Colour: L*a*b* 31 1 -7; Munsell 7PB 3/2
Bought from the Rev. G.J. Chester in 1883.
Reg. no. GR 1883,0621,11



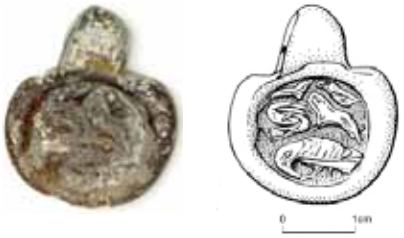
Translucent dark blue disc with rolled rim and suspension loop; iridescence on all surfaces. A horse facing and moving to left; in the field above it, an indeterminate object. The die has been struck off axis.
Cf. Burger 1966, 134–5, fig. 122, 340/7, but the horse moving to right (from grave 340 in the cemetery at Ságvár, Hungary).

Iconography: In multiple ancient cultures, the horse was the quintessential domestic prestige animal, the property of gods, heroes, kings, aristocrats, high-status warriors. There were sacred horses, horse cults (e.g. Poseidon-Hippios) and horse sacrifice. Equine imagery in ancient literature is extensive,[155] as it is in iconography. Horses figured prominently in ancient warfare, hunting and racing.[156] From the period of Late Antiquity, we have a very large collection of sources (Greek, Roman and barbarian) some of them literary-documentary (e.g. Vegetius),[157] others archaeological and iconographic. The specific values that wearers of jewellery might have attached to glass medallions stamped with horse imagery are not known; *cf.* cat. no. 24 *supra*. (PCF)

Unpublished.

85. Glass pendant

4th century
h. 24.2mm; w. 20.2mm; max d. of incuse 14mm; wt 2.2g
Colour: L*a*b*37 1 4; Munsell 7YR 3/1
Reg. no. GR 1976,0916.5



Translucent discoloured brown disc with rolled rim and suspension loop. Three superimposed registers with animals. Top register: two opposing hawks (?); middle register: a caprid (?) and a quadruped, possibly a lion; lower register: a raven (?).
Cf. Barag 2001, no. 402, 184, pl. 30; Barag 2002, no. LA-38, 321; Whitehouse 2003, no. 901; Arveiller-Dulong and Nenna 2011, no. 67, 54.

Iconography: Despite the considerable lack of clarity in the iconographic details on this incuse field, the arrangement of elements and the basics of iconography are clear, thanks to a parallel in the Borowski Collection.[158] The field is divided into three sectors of unequal size and there are five iconographic components; in the upper (smallest) sector: opposing birds, in the middle (larger) sector: a lion chasing its prey, in the lower (largest) sector, a thick-necked, heavy-billed, short-legged bird facing left. Identification of the birds in the upper sector is not possible. The animal being hunted down in the middle sector is probably a caprid (a familiar presence in leonine iconography). The bill, head of the bird in the lower sector points to passerines (Corvidae: ravens), but the bird's heavy body and short, stubby legs points in the direction of galliformes – the best recent thumbnail sketch (with bibliography) of Levantine avifauna, reconstructed from mosaic iconography in the north aisle of the Petra basilica, is Studer's essay in classification.[159] What these five images were meant to signify is unclear – in very general terms, the lion chase signifies power. Lacking a context, it is difficult to assign meanings for the iconography on the incuse field of this glass pendant. (PCF)

Published: Tatton-Brown 1995, 40, fig. 9b.

Non-figural: inanimate objects

86. Glass pendant

4th century
Provenience: Tyre.
h. 22.7mm; w. 19mm; max d. of incuse 13.5mm; wt 1.6g
Colour: L*a*b* 30 8 11; Munsell 6YR 3/3
Given by Sir Augustus W. Franks in 1889.
Reg. no. PE 1889,0706.91

Translucent brown disc with rolled rim and suspension loop. A menorah with a tripod base; in the field to left, a shofar; to right, an ethrog and a lulav.
Cf. Eisen and Kouchakji 1927, pl. 132, fig. 230, 533; Iliffe 1934, no. 6, 12, pl. 8.1 (from Tarshihā, Israel); Reifenberg 1932, 213, pl. 8. III; Schwabe and Reifenberg 1935, 345; Reifenberg 1937, pl. 56; Neuberg 1949, pl. 30, fig. 103; Goodenough 1953, figs. 1019–20; Cambi 1974, no. br.II 22, 151, pl. 1 (from Solin, near Split); IMN 1978, 83; Prausnitz 1986, 463, fig. 5; Sale catalogue 1989, nos 270–2, 76–7; Sale catalogue 1994, no. 827, 116, pl. 42; Gonen 1997, no. 29, 33; Barag 2001, nos 371–3, 181, pl. 29; Barag 2002, nos LA-1 – LA-2, 309; Sale catalogue 2007, no. 494, 102. See Lehrer 1972, 131–2 for a bracelet fragment from near Banyas, Israel, stamped with three menorahs, and Spaer 1988, no. 6, 58, fig. 8a for a glass bracelet stamped with sixteen repeating menorahs; Sale catalogue 1989, no. 292, 78–9, for a bracelet fragment with one menorah. The motif is also found on silver and copper-alloy rings dating from the 6th century: Sale catalogue 1989, nos 323 (menorah with a bust, a dove, a scorpion, a lion, a bull), 324, 325 (and inscribed ΥΓΙΑ ΜΙΧΑΗΛ) and 326.
Gems: Spier 2007, nos 940–53.

Iconography: The seven-branched lampstand was the quintessential cult icon of Jewish identity in Late Antiquity, more than the ark, more than the Temple (in Jerusalem), more than any other Jewish symbol.[160] (PCF)

Published: Dalton 1901, no. 703.

87. Glass pendant

4th century
h. 21mm; w. 18.1mm; max d. of incuse 13mm; wt 1.5g
Colour: L*a*b*42 -17 62; Munsell 9BG 4/4
Reg. no. PE 1983,1108.61

Opaque turquoise disc with rolled rim and suspension loop. A menorah with a tripod base; in the field to left, an ethrog; to right, a lulav.
Cf. cat. no. 86.

Unpublished.

88. Glass pendant

4th century
h. 23.9mm; w. 17.5mm; max d. of incuse 13.5mm; wt 1.4g
Colour: L*a*b*41 -4 4; Munsell 1GY 4/1 Dirty
Bought from the Rev. G.J. Chester in 1882.
Reg. no. PE 1882,0510.35

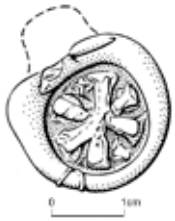
Translucent green disc with rolled rim and suspension loop. A menorah with an oblong

base; in the field to left, an ethrog; to right, a lulav.
Cf. cat. no. 86.

Published: Dalton 1901, no. 704.

89. Glass pendant

4th century
Max d. 17.2mm; max d. of incuse 11.5mm; wt 1.4g
Colour: L*a*b*44 -4 10; Munsell 6GY 4/2
Bought from the Rev. G.J. Chester in 1875.
Reg. no. PE 1875,0522.3



Translucent light green disc with rolled rim; suspension loop missing. A rather blurred design which may be an *iota/chi* cross or a six-pointed star. At the 12 and 6 o'clock positions, between the arms, a blob.
Cf. Zouhdi 1978, no. IIc, 61, fig. 4b (from Hauran, Syria); Sale catalogue 1989, no. 277, 76–7; Stiegemann 2001, no. IV.18.2, 300–1; Wamser 2004, no. 598, 319; Stern 2001, no. 215, 382, for a pendant with an eight-pointed star. For examples where the cross is flanked by an alpha and omega, see: Tzaferis 1989, no. 71, 133, fig. 72:71, pl. 2:d for an example from Capernaum (but misidentified in the text as a gem); Barag 2001, no. 374, 181, pl. 30; Whitehouse 2003, no. 905. There is also an unpublished example in the C.S. collection in Munich (no. 0553).

Iconography: For Christians the cross was the equivalent (and antitype) of the menorah. Two types are represented here (cat. nos 89–90), the *iota-chi* cross (signifying in Greek the initial letters of the name Jesus and epithet Christ) and a 6th-century version of the equilateral cross (cat. no. 90), also called *crux quadrata* or Greek cross.[161] (PCF)

Published: Dalton 1901, no. 706.

90. Glass pendant

6th century
h. 31.7mm; w. 24.3mm; max d. of incuse 16mm; wt 4.6g
Colour: L*a*b* 29 0 10; Munsell 5PB 3/5
Bought from the Rev. G.J. Chester in 1891.
Reg. no. PE 1891,0512.14

Translucent light blue disc with rolled rim and ribbed suspension loop.Within a narrow braided annular frame, a Greek (equilateral) cross. In the angles of the arms, a blob,

possibly intended as stars. The die is struck slightly off axis.

Cf. Gonen 1997, no. 29, 33; Israeli and Mevorah 2000, 143 and 222; Whitehouse 2003, no. 906.

Published: Dalton 1901, no. 705.

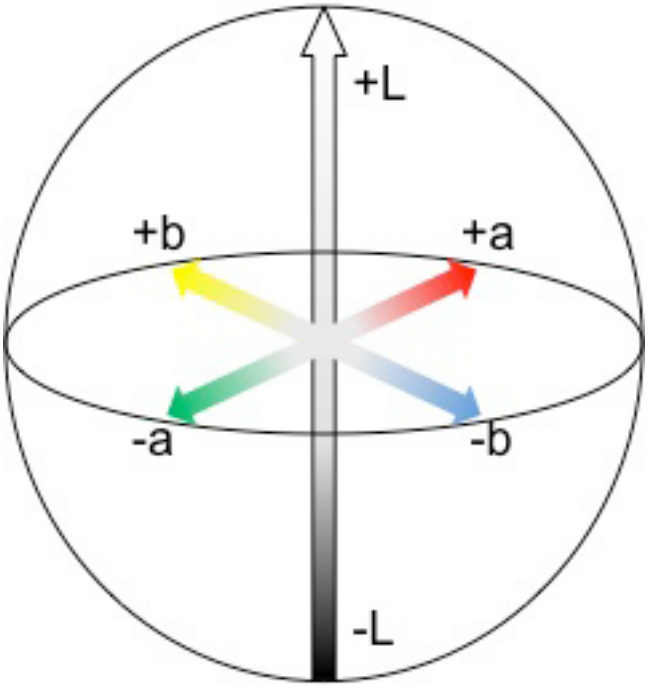
Plate 11 Terracotta pilgrim token with stylite saint, Syria, 5th–6th century. London, British Museum (PE 1991,0601.1)

Appendix A
Measurement of Colour

Philip Fletcher

Colour was measured using a Konica-Minolta CM2600d spectrophotometer with a small measurement aperture (3mm). Pendants were placed onto cotton wool whilst five measurements were made on the reverse of each pendant and the average colour value was taken. CIE L*a*b* values were calculated using D65 illumination with a 10° observer, whilst Munsell values were calculated with C illuminant and 2° observer. In both cases the specular reflection component was included.

CIE L*a*b* is a method for representing colour where, as indicated in the diagram below, L* is the lightness of the specimen being measured with a scale from 0 for a black sample to 100 for a pure white diffuse reflective sample. A* is a scale of green to magenta with negative values being green and positive samples being magenta, likewise b* is a scale from negative value being blue to positive values being yellow.



The Munsell colour specifies a colour using three parameters: Hue (H), Value (v) and Chroma (c). Hue is reported on a scale from 0 to 10 along with characters representing the colour (Yellow (Y), Yellow-Red (YR), Red (R), Red-Purple (RP), Purple (P), Purple-Blue (PB), Blue (B), Blue-Green (BG), Green (G) and Green-Yellow (GY)). Value is a measure of lightness from 0 being black to 10 being white, and Chroma is specified from 0 to 14 and is a measure of the purity of colour which is related to the saturation.

There is no direct comparison between the two colour systems, however lookup tables can be created providing L*a*b* values for each colour in the Munsell palette.

Table 1 Results

Pendant	L*	a*	b*	H		V	C
01 1983,1108,49	45	9	31	10	YR	4	4
02 1873,0502,130	35	9	14	8	YR	4	3
03 1983,1108,52	32	-9	-4	2	B	3	3
04 1891,0613,26	40	5	10	9	YR	4	3
05 1983,1108,53	45	8	29	2	Y	4	4
06 2007,8045,224	43	11	29	10	YR	4	5
07 1906,1020,4	39	10	18	7	YR	4	4
08 1976,0916,4	42	12	30	9	YR	4	5
09 1976,0916,3	43	6	14	10	YR	3	2
10 1980,0611,82	42	6	21	2	Y	4	4
11 1882,1127,30							
12 1867,9-15,109	34	-3	7	1	GY	4	2
13 1983,1108,51	44	10	29	10	YR	4	6
14 1983,1108,46	44	5	24	2	Y	4	4
15 1980,0611,83	35	9	15	5	YR	3	2
16 1980,0611,84	43	6	23	1	Y	4	2
17 1905,0513,9	69	-3	4	10	YR	5	2
18 1871,0616,35	48	4	27	4	Y	4	5
19 1895,1219,1	44	5	25	4	Y	5	5
20 1896,0616,1	57	3	38	4	Y	6	5
21 1983,1108,45	44	9	27	0	Y	4	4
22 1917,0601,2944	63	-10	8	10	GY	5	2
23 1923,1107,1	58	4	36	4	Y	6	5
24 1887,0706,11	35	0	10	4	Y	3	2
25 1879,0522,48	30	-10	-5	1	B	3	2
26 1983,1108,50	31	-9	-1	6	B	2	4
27 102945	79	4	16				
28 1983,1108,47	51	3	26	4	Y	6	5
29 1871,0123,6	41	4	21	3	Y	4	3
30 1983,1108,48	34	10	17	7	YR	3	5
31 1881,0719,33	36	11	20	8	YR	3	4
32 1883,06021,16	34	11	16	6	YR	3	4
33 1900,1016,2	40	10	26	9	YR	4	4
34 1871,0123,10	27	0	-1	1	PB	2	1
35 1871,0123,11	24	1	-3	5	PB	2	1
36 1981,0601,11	29	1	-4	8	PB	3	1
37 1986,0609,25	48	3	32	5	Y	5	5
38 1884,0509,7	28	1	-1	7	PB	2	1
39 1884,0509,8	40	0	16	7	Y	4	3
40 1887,076,12	32	0	10	5	Y	3	1
41 1892,0317.94	40	5	23	2	Y	4	3
42 1892,0317,95	29	-2	-3	8	B	8	1
43 1873,0502,208	30	4	4	4	YR	3	1
441983,1108,58	40	8	23	9	YR	4	4
451983,1108,57	38	6	19	1	Y	4	3
461908,0615,17	45	5	24	3	Y	5	4
47 1908,0615,15	38	5	13	1	Y	4	4

Pendant	L*	a*	b*	H		V	C
48 1983,1108,59	41	6	24	2	Y	4	3
49 1875,0522,2	38	7	18	1	Y	4	3
50 1875,0522,1	50	7	33	1	Y	4	5
51 1883,0621,12	34	0	-9	7	PB	3	2
52 1980,0611,89	35	9	17	9	YR	3	3
53 102772	35	7	17	1	Y	3	3
54 1908,0615,18	47	4	12	10	YR	4	3
55 1871,0616,34	31	9	14	7	YR	3	2
56 1980,0611,86	32	4	7	8	YR	3	1
57 1983,1108,55	45	6	20	1	YR	4	3
58 1983,1108,56	48	4	16	1	Y	4	2
59 1872,0726,33	37	-12	16	9	B	3	5
60 1980,0611,88	31	7	9	6	YR	3	3
61 1874,0716,7	43	13	33	1	Y	4	8
62 1871,0123,9	37	9	18	8	YR	3	4
63 1980,0611,87	26	2	-8	7	PB	3	2
64 1976,0916,2	41	7	22	1	Y	4	4
65 1883,0621,14	35	8	17	8	YR	3	2
66 1887,0706,9	41	-3	13	1	GY	5	3
67 1887,0706,9	43	-3	15	1	GY	5	3
68 1887,0706,9	38	-2	19	10	Y	4	3
69 1874,0716,6	24	1	-5	9	PB	2	1
70 1887,0706,9	26	2	-13	7	PB	3	3
71 1887,0706,9	29	1	-11	6	PB	3	4
72 1976,0916,1	29	6	8	7	YR	3	1
73 1983,1108,54	36	10	20	9	YR	3	5
74 1871,0616,33	32	1	-1	9	PB	3	0
75 1908,0615,16	37	5	19	3	Y	4	4
76 1871,0123,8	44	5	15	1	Y	4	2
77 1876,0527,19	39	7	23	10	YR	3	3
78 1883,0621,13	29	-1	-5	5	PB	2	1
79 1884,0509,5	32	-3	-2	7	B	3	1
80 1884,0509,6	34	-6	2	2	BG	3	2
81 1887,0706,10	28	-5	4	0	GY	3	1
82 1869,0709,98	37	7	18	1	Y	4	4
83 183,1108,60	35	4	15	1	Y	3	3
84 1883,0621,11	31	1	-7	7	PB	3	2
85 1976,0916,5	37	1	4	7	YR	3	1
86 1889,0706,91	30	8	11	6	YR	3	3
87 1883,1108,61	42	-17	-6	9	BG	4	4
88 1882,0510,35	41	-4	4	1	GY	4	1
89 1875,0522,3	44	-4	10	6	GY	4	2
90 1891,0512.14	29	0	10	5	PB	3	5

Notes

1 Originally located in six of the Museum's curatorial departments, the pendants are now divided between the Departments of Prehistory and Europe (40 examples), Greece and Rome (41 examples), the Middle East (8 examples), and Ancient Egypt and Sudan (1 example). Just under half of the pendants were collected in the 19th century (between the years 1871 and 1895) by the then Departments of Greek and Roman Antiquities (34 examples), British and Medieval Antiquities (11 examples), Western Asiatic Antiquities (2 examples) and Egyptian Antiquities (1 example). Many of these 19th-century acquisitions were obtained from the Reverend G.J. Chester (31 pieces) or were given by the executors of the glass collector Felix Slade (11 examples). The 40 or so examples acquired during the course of the 20th century came from numerous small purchases or gifts, none of any great importance. Many indeed were never even formally recorded at the time of their acquisition and two of the largest groups, those from 1976 and 1983, are of previously unregistered pendants respectively in the Department of Greece and Rome and the Department of Asia.

2 Only about 300–400 examples are known in the literature in marked contrast, for instance, to the thousands of gems which have survived from the Roman imperial period.

3 See Trzcionka 2007.

4 The reason/s for this decline in gemstone use, which becomes apparent from the mid-3rd century onwards, is still debated. It could be due to a number of factors: a change in sealing practices, disruption of the trade routes which supplied many of the gemstones or simply a change in fashion.

5 Imperial legislation of the 4th century distinguishes between sorcery (*veneficium*) and magic (*maleficium*). On the terrible punishments visited upon those convicted of such crimes, and which included sorcerers (*veneficus*), magicians (*magi/malefici*), soothsayers (*haruspex*), enchanters (*incantantores*), conjurers (*immisores*) and astrologers (*mathematicus*) see: *CTh.* 9.16; 9.38, 3-4 and 7–8; 9.40,1; 9.42,2; 9.42,4; 11.36,1; 11.36,7; 16.5,34. According to Ammianus Marcellinus the Emperor Constantius II condemned to death anyone who 'wore on his neck an amulet against the quartan ague or any other complaint' (xix.xii.13). The early Church Fathers were equally condemnatory: John Chrysostom, for instance, inveighed against the use of amulets by women (*In epist. ad Colossenses* III, VIII, 5) and the Council of Laodikeia, sometime after AD 345, forbade the clergy from the manufacture of amulets. On the pervasiveness of the notion amongst educated Christians and the Church Fathers that good fortune was vulnerable to the attacks of envious supernatural forces (Gr. φθόνος or βασκανία, Lat. *invidia* and *fascinatio*) and on attitudes in general to the Evil Eye see, Dickie 1995, 9–33, esp. 18–30. See also Dunbabin and Dickie 1983, 9–37.

6 The literature on these pendants is largely concerned with the publication of isolated archaeological finds or of those pendants included almost as afterthoughts in various catalogues *raisonné* of more general related material such as classical gems or Late Antique glass (*cf.* Brandt *et al.* 1972; Zwierlein-Diehl 1991). Of the earlier excavated material mention should be made of Iliffe's publication of the pendants from Tarshihā in Israel (Iliffe 1934), simply because most subsequent publications have generally followed the 4th-century date suggested by him for the majority of pendants. Of the numerous papers published since Iliffe, Cambi's publication of the pendants in the Archaeological Museum in Split (Cambi 1974) and Zouhdi's of pendants in the National Museum in Damascus (Zouhdi 1978) are both useful for presenting large groups of these pendants, although neither offers much in the way of detailed analysis. It is only recently, in two articles published in 2001 and 2002, analyzing material respectively in the Israel Museum and in the Borowski Collection, that Dan Barag has adopted a more systematic approach to this group of material.

7 Brandt, for instance, employs this term when describing the pendants in the collection of the Staatliche Sammlung in Munich.

8 See Smith 1995, 21–2. This paste is a high lead glass which is frequently coloured. Tassie first took a sulphur cast from the gem. A plaster positive was then made from the original negative and then a plaster negative from which a sulphur positive was made. This was then used as the master. A mixture of Tripoli and plaster of Paris was then used to make a mould into which the positive master was pressed and then removed. A slab of glass paste was then heated to an appropriate temperature in the furnace, removed and then pressed into the mould, where it annealed. It was subsequently removed from the mould, cleaned and trimmed if necessary.

9 For 'trilobitenperlen' see: Haeverninck 1974, 105–29; Gesztelyi 1998, 129–36; Spaer 2001, 66 and 76.

10 I am grateful to Rosemarie Lierke not only for sharing her thoughts on how these pendant loops were made but also for providing the illustrations which comprise **Fig. 1**.

11 It would not have been possible for a flattened loop to have been drawn out with pincers and then pierced with a hot wire as it would have stuck to the glass. The only way to have prevented this would have been to apply a protective layer to the wire/rod; the difficulty with this is that it is hard to imagine this layer adhering to the wire when pushed through the loop. On the contrary it is theoretically possible to fold or press the hot glass over a wire/rod with a covering layer and then withdraw the wire/rod afterwards. Alternatively, the glassworker could generate a hole or loop with a stick of organic material like wood or charcoal which would burn out and leave a hole. This method would not, however, explain those pendants whose loops have flattened shoulders, or those which have a distinctive channel found at the base of the loop – surely an indication of where the rod was pressed to hold the glass body whilst a trail is drawn from it for the loop. The rod or wire employed for these squeezed loops would have had an appreciably smaller diameter.

12 Barag 2001, 173–4.

13 The only real evidence for suggesting a later date for some of the pendants with the larger twisted loops comes from analyses of the Museum's pendants undertaken by Röhrs and Meek in the following paper.

14 On the batch and its importance see: Freestone, Price and Cartwright 2009, 130–4.

15 http://www.konicaminolta.com/instruments/products/color-measurement /spectrophotometer/ cm2600d-2500d/index.html.

16 Dr Yael Gorin-Rosen in an email dated 04/07/12 kindly confirms that in Israel 'it is a rare colour for vessels during the Late Roman period'.

17 For some examples in the Corning Museum of Glass, see: Whitehouse 2003, 27–42, where they are dated to the 4th to 6th century.

18 Milne 1933, xxxix (ibis), xxix (personification of Nile), xxx (Nike), xxxi, xxvii-xxviii (Herakles).

19 See Entwistle 1998, 153–5 and nos 208–16 for a number of examples and a select bibliography.

20 Weinberg 1988, passim.

21 Brill 1988, 273, concludes that 'none of the Jalame glass can be classified as true amber, but it has been proved that olive and olive-amber glasses from Jalame contain the ferri-sulfide complex, which modifies the basic aqua of the ferrous ion to olive and olive-amber'.

22 O'Hea 2001, 370–6. Apart from a small number of tesserae, the colour seems absent from the numerous glass finds at the church and chapel of Jabal Hārūn approximately 5km from Petra (Keller and Lindblom 2008, 331–68).

23 O'Hea 2013, 295 comments that of the 15,356g of glass weighed from the site 'neither amber nor cobalt glass reached even 1% of the assemblage'. One should note, however, that the majority of the glass dates to the later 6th and 7th centuries.

24 Freestone and Stapleton 2013, with bibliography.

25 Ibid. Ian Freestone has also remarked (pers. comm. email 10/1/13): 'Amber is likely to have formed in the tank furnace in some cases. It is unlikely (but not impossible) that the glassmakers could control this. Therefore its appearance would have been something of an accident. It is quite possible that it would have been conserved for specific clients/purposes. The colour may not have survived repeated remelting or recycling. At the moment (....) I think it is very unlikely that someone in a glass workshop could have deliberately made amber'.

26 For a summary of the finds from Beit Eli'ezer see, Gorin-Rosen

2000, 52–4. It has been estimated that even if the 17 furnaces were only fired once around one million glass vessels of a typical weight of around 150g would have been produced: Freestone, Gorin-Rosen and Hughes 2000, 67.

27 Cat. no. 90, which weighs 4.6g, is not included as it is the only example to date to the 6th century.

28 There is no literary evidence to suggest that glass was regarded as a suitable medium for amulets, althought the absence of any mention of it in the *PGM* or *Orphic Lithika* is perhaps not surprising given that these largely reflect Egyptian magical traditions. I am aware of only a very few surviving glass amulets before or after the 4th century. One early example (imperial Roman) from Egypt depicts Thoth, although this is strictly speaking made of Egpytian faience. Nevertheless, it is identical morphologically to the pendants: see Gombert-Meurice 2012, 285, fig. 269c. For an interesting later 'glass paste' from Anemurium, which is inscribed with the trisagion on one side and a Greek inscription resolving as 'The seal of Solomon restrains the Evil Eye' on the reverse, see: Russell 1995, 39, figs 2–4.

29 See Terry in this volume, who uses this phrase to describe the use of amber tesserae at the Eufrasian basilica at Poreč and further comments that the colour 'functioned as a wild card in the mosaicists palette, being warm, light as well as dark, and light-generating in its near transparency'.

30 Non-funerary contexts include *villae* (e.g. Gorbelhof, Switzerland) and basilicas (e.g. Tiberias).

31 Burger 1966, 99–234.

32 Ibid., 134–5, fig. 122.

33 Sági 1981, 28–30, figs 13–15.

34 Exhibition catalogue 1994, no. I.31, 103–5.

35 Peleg 1991, 131–52.

36 Iliffe 1934, 9–16.

37 Warmenbol 2006, no. 122, 292.

38 Spartz 1967, no. 160, pl. 38; Naumann 1980, no. 20, pl. 4.

39 Cesnola 1903, nos 6, 8, 10, pl. 18.

40 Conyngham 1849, 174.

41 Spaer 1988, 58, includes examples stamped with a menorah with lulav and ethrog, a chi-rho with alpha and omega, an orant figure between two animals, a lion, and a lion with star and crescent moon; see also Spaer 2001, nos 451–4, 200. Unfortunately, few of these bracelets or bracelet fragments come from stratified contexts, although like the pendants they tend to be found in northern Israel and must surely date to the 4th century.

42 Eisen and Kouchakji 1927, 532.

43 Before him, still in the 20th century, there was the exhaustive [and exhausting] treatment by Hopfner 1921, §378–881; idem, 1924, §260ff.; more recently, we have a briefer, informative presentation by Michel 2004, Gesamtregister: Amulett.

44 *Cf.* Basil, *Homily on Psalm 29*, Migne *PG* 29, 418: περίεργοι χαρακτήρες.

45 They are Syro-Palestinian in provenience, 5th or 6th century in date, and fashioned as pendants with extruded loops; *cf.* Sale catalogue 1989, nos 176–99, for a good selection of the standard types; also, Michel 2001, nos 451–6.

46 *Cf.* Clement, *Prot.* 11.115,1; Beck 1928, 21 used the word 'bulla' to classify stamped glass pendants understood as objects that impart an amuletic intent; *cf.* M. Cassis, 'Bulla', *EECAA*, s.v.

47 Hopfner 1921, §802ff.; *cf.* Nilsson 1961, Index II. Sachen: Kraftlehre, s.v.

48 Dunbabin and Dickie 1983, 7–38; Trzcionka 2007, Index: envy.

49 Goodenough 1951, 308–16.

50 The exceptions being cat. nos 15 and 16 (inscribed NIKH) and cat. no. 65 (EIC ΘEOC). This largely holds true for other collections as well, the only other inscriptions known to me being: AΓIC WNY (with a female bust), ZOH (with confronted male and female busts or a frog), ZOHN (with a frog), IHC OV (with Christ), EYTYXH (with Herakles), IAW (with a lion), and [CYM]EWN (with a stylite saint).

51 Deubner 1911, 433–9.

52 Kotansky 1991, 108.

53 For Eros see, Michel-von Dungern 2011, 85, pls 9a–d.

54 See the following paper, Fig. 1; Freestone, Gorin-Rosen and Hughes 2000, 65–74.

55 Haeverninck 1973, 105–8; Magyar 2009, 101–3. These are also referred to in the literature as 'kettenglieder' or (rather more clumsily) as 'Glaskameen mit zwei kanälen'.

56 Haeverninck 1973, pl. 1: 15.

57 Ibid., pl. 1: 10, 14; pl. 2: 7–8; Mandruzzato nos B4a–c, 162; Arveiller-Dulong and Nenna 2011, nos 63–4.

58 For a distribution map see Haeverninck 1973, 112.

59 Their presence in these regions could be explained by factors other than local production. Although the Roman army in the form of legionary movements can probably be ruled out as a distribution mechanism, there were still major movements of troops between the Danubian and eastern frontiers in the 4th century and Aquileia and Split were both important entrepots, as well as military and administrative centres, which will have served their immediate hinterlands as well as the north-eastern *limes* along which some of the pendants have been discovered. If not the military, then other government personnel, such as those connected with the administration of the *annona* could have contributed to the overall distribution pattern. Other factors, such as trade and the burgeoning pilgrimage industry, cannot be ruled out either. There is not the space in this paper to consider these possibilities further.

60 Reg. no. CM R 0520.

61 RIC 273c: an antonianus of Caracalla dated to AD 215.

62 Carson 1980a, nos 977, 981, 987, 128–30.

63 Conyngham 1849, 174.

64 Raynaud 2001, 215–16.

65 Adam-Veleni 2010, no. 271, 297.

66 Sagi 1981, 28–30.

67 Burger 1966, 134–5, fig. 122, 340/7.

68 Exh. catalogue 1994, 104–5.

69 Schultze and Gudkova 2012.

70 Chéhab 1986, 67, pl. XLIV.

71 Ibid., 510, pl. XLV.

72 Ibid., 656, pl. XLV.

73 Ibid., 680, pl. XLV.

74 Ibid., 438, pl. XLIV.

75 Iliffe 1934, 11–12.

76 Peleg 1991, 131–52.

77 Porat 1997, 81–8 (Eng. summary, 15).

78 Tatcher and Gal 2011, 1–47.

79 Abu 'Uqsa 2005.

80 Hirschfeld and Peleg 2006, 201–8.

81 Finkbeiner and Sakal 2010, 9, pl. 19 c and e.

82 *Cf.* Fossing 1929, 23.

83 *Institores*: Finney 1994, 121, n. 83.

84 Spier 1993, passim.

85 The archaeological evidence in the Syro/Palestinian area suggests that copper-alloy finger-rings gradually replaced glass pendants as the amulet of choice at some point in the 5th century. This is indicated by the many rings engraved with the figures of lions accompanied by a star or crescent which have been found in funerary contexts at such sites such as Sajur, el-Jish/Gusha Halav and Khirbet al-Karak in northern Israel through to Tel Hammeh and Jebel Joffeh (Amman) in central Jordan to Shivta in the Negev. Lions as apotropaic figures were also widely employed on a group of slightly later pendant amulets made from thin copper-alloy sheet and generally described as 'Syro-Palestinian'. On these they appear in more varied iconographic scenes, often juxtaposed with the Holy Rider spearing Lilith, or with a snake, a scorpion and a stork attacking a 'suffering' evil eye; the inscriptions on these pendants – such as IAΩ CABAO MIXAHA, or the opening words of Psalm 91 – suggest a more Christianized context.

86 *Cf.* Small 1994, 639–44.

87 *Cf.* Weigel 1992, s.v.

88 Ibid., nos 5–41.

89 Cumont 1942, General Index: Apothéose de Romulus

90 λαμπραὶ δ΄ακτινες; Hymn 31, line 10: Allen *et al.*, 1936².

91 *Lunula:* Tertullian, *CultFem* ii.10.4.

92 Halsberghe 1972; Berrens 2004.

93 CIL 6.715.

94 L'Orange and Gerkan 1939.

95 Alföldi 1964, 10–16.

96 Hopfner 1921–4, I. 'Isis' Index, s.v.
97 Merkelbach 1995.
98 Bricault 2001.
99 Tam Tinh 1990, s.v.
100 Hopfner 1921-4, 158, 483, 693; Dunand 1981, nos 40–1; Clerc and Leclant 1994, nos 208–10.
101 *Cf.* Hermary *et al.* 1986, 850 ff., nos 157ff.; Blanc and Gury 1986, 952ff., nos 157ff; Schwartz 1999, 13–45.
102 Hopfner 1921–4, Index: 'Hekate', s.v.
103 Kahil and Icard 1984, 'Artemis', s.v.
104 Ibid., cat. nos 1394–1417.
105 Nash 1968, 63ff.; Latte 1960 §158: Tracht.
106 *Cf.* Finney forthcoming, 'Horn of Plenty', s.v.
107 *Cf.* Villard 1997, 115ff.
108 Dalton 1901, nos 334 (Antioch) and 335 (Alexandria).
119 Rausa 1997, cat. nos 1b-3, 9a, 9c, 16, 18a and 18b.
110 Moustaka *et al.* 1992, 850ff.
111 Volkommer 1997, 237–68; Weinstock 1958, 2501–42.
112 *Cf.* Grote 1992.
113 Finney forthcoming, 'Concordia Apostolorum', s.v.
114 Ibid., 'Concordia', s.v.
115 Finney 1994, 179, no. 7; see also Spier 2007, pls 7–11.
116 Dalton 1901, no. 207; *cf.* nos 209–10.
117 Nilsson 1959, Index 2: 'Phallos', s.v.
118 *Cf.* Thraede 1994, 235.
119 Nash 1968, 391–2.
120 *Cf.* Schliermacher 1984.
121 *Cf.* Brune 1999; Walter 2003.
122 Alföldi 1963, cat. no. 118.
123 MacCormack 1981, 17ff.
124 For a catalogue of examples, *cf.* Ihm 1992, 127ff.
125 *Cf.* Veyries 1984.
126 *Cf.* Schumacher 1977.
127 *Cf.* Harley and Viellfon forthcoming, 'Shepherd', s.v.
128 *Cf.* Sörries forthcoming, 'Daniel', s.v.
129 Barag 2002, cat. no. LA-5.
130 Buckton 1994, no. 129.
131 *Cf.* Engemann and Peers forthcoming, 'Stylite', s.v.
132 *Cf.* Sodini forthcoming, s.v.
133 *Cf.* Nilsson 1955, Index of Names: 'Lamia', s.v.; Boardman 1992, 189.
134 *Cf.* Nilsson 1955, 201ff, 409ff.
135 *Cf.* Krauskopf and Dahlinger 1988, 285–330.
136 *Cf.* Paoletti 1988, 345–62.
137 *Cf.* Gager forthcoming, s.v.
138 Halleux and Schamp 1985, 242–3.
139 For an example of a coral with a Medusa head see: Mastrocinque 2011, pl. 3a.
140 Gundel 1925, 1975–8.
141 On the crescent moon in the Leo constellation see: Neugebauer 1975, 575.
142 Schwartz and Schwartz 1979, 161–3.
143 Hopfner 1921–4, §461; Dodds 1992, 303ff.
144 *Cf.* Tarn 1954, 701ff.
145 Babelon 1901, vol. 2.
146 Platz-Horster 1984, no. 29; Zazoff 1983, Index: 'Lowe', s.v.
147 Bonner 1950, no. 370.
148 Boll 1903, 190ff.
149 *Cf.* Keller 1909–13, 470–9.
150 *Cf. PGM* 3. Index 1: 'Skorpios', s.v.
151 *Cf.* Boll 1903, Index: 'Skorpion', s.v.
152 Bonner 1950, 77–8.
153 Keller 1909–13, 296ff.
154 On the assimilation of Zeus to Amon see, Keller 1909–13, 321ff.
155 E.g. Norden 1926, 77–80.
156 Keller 1909–13, 218ff; Toynbee 1973, Index II: 'Horses', s.v.
157 *Cf.* Lommatsch 1903.
158 Barag 2002, cat. no. LA-38.
159 Studer 2001, 271ff.
160 *Cf.* Meyers forthcoming, 'Lampstand [Jewish]', s.v.
161 Finney 1997, 'Cross', s.v.

Bibliography

Abbreviations

AGDS 1.1 E. Brandt, *Antike Gemmen in deutschen Sammlungen. Band 1, Staatliche Münzsammlung München. Teil 1. Griechische Gemmen von minoischer Zeit bis zum späten Hellenismus*, Munich, 1968.

AGDS 1.2 E. Brandt and E. Schmidt, *Antike Gemmen in deutschen Sammlungen. Band 1, Staatliche Münzsammlung München. Teil* 2. *Italienische Gemmen etruskisch bis römisch-republikanisch. Italienische Glaspasten vorkaiserzeitlich bearbeitet*, Munich, 1968–70.

AGDS 1.3 E. Brandt, A. Krug, P. Gercke and E. Schmidt, *Antike Gemmen in deutschen Sammlungen. Band 1, Staatliche Müunzsammlung München Teil 3 -Gemmen und Glaspasten der römischen Kaiserzeit sowie Nachträge*, Munich, 1972.

AGDS 2 E. Zwierlein-Diehl, *Antike Gemmen in deutschen Sammlungen. Band II, Staatliche Museen, Preußischer Kulturbesitz. Antikenabteilung Berlin*, Munich, 1969.

AGDS 3 V. Scherf, P. Gercke and P. Zazoff, *Antike Gemmen in deutschen Sammlungen. Band III, Braunschweig, Göttingen, Kassel*, Wiesbaden, 1970.

AGDS 4 M. Schlüter, G. Platz-Horster and P. Zazoff, *Antike Gemmen in deutschen Sammlungen. Band IV, Hannover, Hamburg*, Wiesbaden, 1975.

AGWien I E. Zwierlein-Diehl, *Die antiken Gemmen des Kunsthistorisches Museums in Wien. Die Gemmen von der minoischen Zeit bis zur frühen römischen Kaiserzeit*, Munich, 1973.

AGWien II E. Zwierlein-Diehl, *Die antiken Gemmen des Kunsthistorischen Museums in Wien, Band II: Die Glasgemmen – Die Glaskameen (Nachträge zu Band I) – Die Gemmen der späteren römischen Kaiserzeit I: Götter*, Munich, 1979.

AGWien III E. Zwierlein-Diehl, A. Bernhard-Walcher and E. Bleibtreu , *Die antiken Gemmen des Kunsthistorischen Museums in Wien, Band III: Die Gemmen der späteren römischen Kaiserzeit – Masken ... ; Nachträge und Ergänzungen zu Bd. 1 und 2 / T. 2*, Munich, 1991.

AIBL	*Académie des inscriptions et belles lettres*
AJN	*American Journal of Numismatics*
ANRW	*Aufstieg und Niedergang der römischen Welt*
ANSMN	*American Numismatic Society. Museum Notes*
BJbb	*Bonner Jahrbücher*
EEC²	*Encyclopedia of Early Christianity* (Ed. E. Ferguson), New York and London, 1997
EECAA	*Encyclopedia of Early Christian Art and Archaeology* (Ed. P.C. Finney), Cambridge (UK) and Grand Rapids, 2014
ILCV	*Inscriptiones Latinae Christianae Veteres*, 4 vols (Ed. E. Diehl), Dublin, 1967–70²
IMN	*Israel Museum News*
JbAC	*Jahrbuch für Antike und Christentum*
JCSSS	*Journal of the Canadian Society for Syriac Studies*
JGS	*Journal of Glass Studies*
JWAG	*Journal of the Walters Art Gallery*
LIMC	*Lexicon iconographicum mythologiae classicae* (Ed. L. Kahil), Zurich, 1981–99
NY.MMA	Metropolitan Museum of Art, New York.*The Johnston Collection of Engraved Gems; Handbook, no. 9*, New York, 1894
PGM	*Papyri Graecae Magicae* (K. Preisendanz, ed. and trans.), 2 vols, Munich, 2001²
QDAP	*The Quarterly of the Department of Antiquities in Palestine*
RAC	*Reallexikon für Antike und Christentum*
RE	*Real-Encyclopädie der classischen Altertumswissenschaft*

Adam-Veleni 2010
P. Adam-Veleni, Γυάλινος κόσμας. *Glass Cosmos* (Archaeological Museum of Thessaloniki, no. 6), Thessaloniki, 2010.

Alekseeva 1978
E.M. Alekseeva, *Antičnye busy Severnogo Pričernomor'ja (Archeologija SSSR. Svod archeologičeskich istočnikov, G.1-12)*, Moscow, 1978.

Alföldi 1963
A. Alföldi, *Die constantinische Goldprägung*, Mainz, 1963.

Alföldi 1964
M.R. Alföldi, 'Die Sol Comes Münze vom Jahre 325. Neues zur Bekehrung Kaiser Konstantins', in *Mullus. Festschrift Theodor Klauser* (JAC.E 1, 16), Munster, 1964, 10–16.

Allen, Halliday and Sikes 1936
T.W. Allen, W.R. Halliday, and E.E. Sikes (eds), *The Homeric Hymns*, Oxford, 1936.
Almeida de 1965
F. de Almeida, 'Antiguidades da Egitânia', *Arqueologia e História*, 8ª ser., vol. 11 (1965), 98–9.
Arveiller-Dulong and Nenna 2011
V. Arveiller-Dulong and M.-D. Nenna, *Les Verres antiques du Musée du Louvre. III. Parures, instruments et elements d'incrustation*, Paris, 2011.
Babelon 1901ff
E. Babelon, *Traité des monnaies grecques et romaines*, Paris, 1901ff.
Bagatti and Milik 1958
P.B. Bagatti and J.T. Milik, *Gli Scavi del "Dominus Flevit" (Monte Oliveto – Gerusalemme). Parte I: La Necropoli del Periodo Romano*, Jerusalem, 1958.
Baldini Lippolis 1989
I. Baldini Lippolis, 'I Gioielli dell'*Antiquarium* di Bosra', *Felix Ravenna* 137/8 (1989), 75–124.
Baldini Lippolis 1999
I. Baldini Lippolis, *L'Oreficeria nell'Impero di Costantinopoli tra IV e VII Secolo*, Bari, 1999.
Barag 1969
D. Barag, 'A Jewish applied glass medallion', *Bulletin of the Museum Haaretz, Tel Aviv*, no. 11 (1969), 39–42.
Barag 2001
D. Barag, 'Stamped pendants', in M. Spaer, *The Israel Museum, Jerusalem. Ancient Glass in the Israel Museum. Beads and Other Small Objects*, Jerusalem, 2001, 173–76 and 179–85.
Barag 2002
D. Barag, 'Late Antique and Byzantine glass', in R.S. Bianchi *et al.* (eds), *Reflections on Ancient Glass from the Borowski Collection. Bible Lands Museum Jerusalem*, Mainz, 2002, 307–28.
Beck 1927
H.C. Beck, 'Classification and nomenclature of beads and pendants', *Archaeologia* 77 (1927), 1–76.
Berrens 2004
S. Berrens, *Sonnenkult und Kaisertum von den Severern bis zu Constantin I (193–337 n. Chr)*, Stuttgart, 2004.
Berry 1968
B.Y. Berry, *Ancient Gems from the Collection of Burton Y. Berry*, Bloomington, 1968.
Bertrand 2000
I. Bertrand, 'Le petit mobilier du sanctuaire gallo-romain du Gué-de-Sciaux (Antigny, Vienne): étude des objets de parure et de toilette', in I. Bertrand (ed.), *Actualité de la recherché sur le mobilier romain non céramique* (Actes du colloque de Chauvigny des 23 et 24 octobre 1998), Poitiers, 2000, 71–101.
Bertoncelj-Kučar 1979
V. Bertoncelj-Kučar, 'Nakit iz stekla in jantarja', *Arheološki Vestnik* 30 (1979), 254–7.
Biran 1980
A. Biran, 'Tel Dan: five years later', *Biblical Archaeologist* 43 (1980), 168–82.
Blanc and Gury 1986
N. Blanc and F. Gury, 'Eros [in Etruria] XIII.B: Amor monté sur un animal', *LIMC* 3.1 (1986), 952ff.
Boardman 1992
J. Boardman, 'Lamia', *LIMC* 6.1 (1992), 189.
Bögli 1961
H. Bögli, 'Archäologie und Nationalstraßenbau 3', *Ur-Schweiz* 25 (1961), 59, pl. 50b.
Boll 1903
F. Boll, *Sphaera*, Leipzig, 1903.
Bomford 1976
J. Bomford, *Ancient Glass. The Bomford Collection of Pre-Roman & Roman Glass on Loan to the City of Bristol Museum & Art Gallery*, Bristol, 1976.
Bonner 1950
C. Bonner, *Studies in Magical Amulets, Chiefly Graeco-Egyptian* (University of Michigan Studies. Humanistic Series Volume XLIX), Ann Arbor, 1950.
Boosen 1984
M. Boosen, *Antike Gläser* (Kataloge der Staatlichen Kunstsammlungen Kassel Nr 11), Kassel, 1984.
Borbély-Kiss *et al.* 1994
I. Borbély-Kiss, Zs. Fülöp, T. Gesztelyi, A.Z. Kiss, E. Kotay and Gy. Szabó, 'The PIXE-PIGE method for classification of late Roman glass sealings', *Nuclear Instruments and Method in Physics Research. Section B* (1994), 836–9.
Boussac and Starakis 1983
M.F. Boussac and P. Starakis, 'Une collection d'intailles et de camées du Musée d'Alexandrie', *Bulletin de Correspondance Hellénique* 107 (1983), 457–95.
Braun, Dauphin and Hadas 1994
E. Braun, C. Dauphin and G. Hadas, 'A rock-cut tomb at Sajur', '*Atiqot* 25 (1994), 102–15.
Bricault 2001
L. Bricault, *Atlas de la diffusion des cultes isiaques (IVe siècle avant J.-C. – IVe siècle après J.-C.)* (AIBL. Mémoire 23), Paris, 2001.
Brill 1988
R.H. Brill, 'Scientific investigations of the Jalame Glass and Related Finds', in G.D. Weinberg (ed.), *Excavations at Jalame: Site of a Glass Factory in Late Roman Palestine*, University of Missouri, Columbia, 1988, 257–94.
Brune 1999
K.-H. Brune, *Der koptische Reiter: Jäger, König, Heiliger…*, Altenberger, 1999.
Buckton 1994
D. Buckton (ed.), *Byzantium: Treasures of Byzantine Art and Culture from British Collections*, London, 1994.
Burger 1966
A. Burger, 'The 4th-century AD cemetery at Ságvár', *Acta Archaeologia Academiae Scientarum Hungaricae* 18 (1966), 99–234.
Cabrol and Leclercq 1938
F. Cabrol and H. Leclercq, 'Pasteur (Bon)', *Dictionnaire d'archéologie chrétienne et de liturgie*, vol. 30/2, Paris, 1938, cols 2272–2390.
Cambi 1974
N. Cambi, 'Neki kasnanticki predmeti od stakla s figuralnim prikazima u Arheoloskom muzeju u Splitu', *Arheološki Vestnik* 35 (1974), 139–57 (volume published in 1976).
Campbell 1985
S.D. Campbell (ed.), *The Malcove Collection. A Catalogue of the Objects in the Lillian Malcove Collection of the University of Toronto,* Toronto and Buffalo, 1985.
Carson 1980a
R.A.G. Carson, *Principal Coins of the Romans. Volume II, The Principate 31 B.C.–A.D. 296*, London, 1980.
Carson 1980b
R.A.G. Carson, *Principal Coins of the Romans: Volume III: The Dominate A.D. 294 – 498*, London, 1980.
Carter 2003
J.C. Carter (ed.), *Crimean Chersonesos: City, Chora, Museum and Environs* (Institute of Classical Archaeology, The University of Texas at Austin), Austin, 2003.
Cesnola 1903
L.P. Cesnola, *A Descriptive Atlas of the Cesnola Collection of Cypriote Antiquities in the Metropolitan Museum of Art, New York*, vol. 3, New York, 1903.
Chéhab 1984
M.H. Chéhab, *Fouilles de Tyre. La Nécropole. Vol. II: Description des Fouilles* (Bulletin du Musée de Beyrouth, vol. XXXIV), Paris, 1984.
Chéhab 1985
M.H. Chéhab, *Fouilles de Tyre. La Nécropole. Vol. III: Description des Fouilles* (Bulletin du Musée de Beyrouth, vol. XXXV), Paris, 1985.
Chéhab 1986
M.H. Chéhab, *Fouilles de Tyre. La Nécropole. Vol. IV: Description des Fouilles* (Bulletin du Musée de Beyrouth, vol. XXXVI), Paris, 1986.
Chiesa 2012
G. Sena Chiesa (ed.), *Costantino 313 d.C*, (exh. cat., Milano, Palazzo Reale), Milan, 2012.
Clerc and Leclant 1994
C. Clerc and J. Leclant, 'Sarapis', *LIMC* 7.1 (1994), 666–92.
Conyngham 1849
A. Conyngham, 'An account of various objects of antiquity, found near Amiens, France, in the spring of 1848', *Archaeologia* 33 (1849), 174.
Crowfoot and Kenyon 1957
J.W. Crowfoot, G.M. Crowfoot and K.M. Kenyon, *The Objects from Samaria*, London, 1957.

D'Agostini 1984
A.D'Agostini, *Gemme del Museo Civico di Ferrara*, Firenze, 1984.
Dalton 1901
O.M. Dalton, *Catalogue of Early Christian Antiquities and Objects from the Christian East in the Department of British and Mediaeval Antiquities and Ethnography of the British Museum*, London, 1901.
Davidson 1952
G.R. Davidson, *Corinth. Volume XII: the Minor Objects*, Princeton, 1952.
Delatte and Derchain 1964
A. Delatte and Ph. Derchain, *Les intailles magiques gréco-égyptiennes. Bibliothèque Nationale, Cabinet des Médailles et Antiques*, Paris, 1964.
Delougaz and Haines 1960
P. Delougaz and R.C. Haines, *A Byzantine Church at Khirbat al-Karak*, Chicago, 1960.
Deubner 1911
L. Deubner, 'Charms and amulets (Greek)', in J. Hastings (ed.), *Encyclopaedia of Religion and Ethics*, vol. 3, New York, 1911, 433–9.
Dickie 1995
M.W. Dickie, 'The fathers of the Church and the evil eye', in H. Maguire (ed.), *Byzantine Magic*, Washington DC, 1995, 9–34.
Dodds 1992
E.R. Dodds (ed.), *Proclus. The Elements of Theology*, Oxford, 1992.
Dölger 1901
F.J. Dölger, *ΙΧΘΥC*, Freiburg, 1901.
Drauschke and Keller 2010
J. Drauschke and D. Keller (eds), *Glass in Byzantium – Production, Usage, Analyses* (Römisch-Germanisches Zentralmuseum Mainz, Tagungen 8), Mainz, 2010.
Dunand 1981
F. Dunand, 'Agathodaimon', *LIMC* 1.1 (1981), 276–82.
Dunbabin and Dickie 1983
K.M.D. Dunbabin and M.W. Dickie, 'Invidia Rumpantur Pectora', *JbAC* 26 (1983), 9–37.
Eger and Hamoud 2011
C. Eger and M. Hamoud, 'Spätrömisch-frühbyzantiner Grabbrauch in Syrien: Die Nekropole von Darayya bei Damaskus', *Antike Welt* 6 (2011), 70–6.
Eisen and Kouchakji 1927
G.A. Eisen and F. Kouchakji, *Glass: its Origin, History, Chronology, Technic and Classification to the Sixteenth Century*, vol. 2, New York, 1927.
Elgavish 1994
J. Elgavish, *Shiqmona. On the Seacoast of Mount Carmel*, Tel Aviv, 1994.
Endrizzi and Marzatico 1997
L. Endrizzi and F. Marzatico (eds), *Ori delle Alpi* (6 Quaderni della Sezione Archeologica Castello del Buonconsiglio. Monumenti e collezioni provinciali), Trento, 1997.
Engemann and Peers forthcoming
J. Engemann and G. Peers, 'Stylite', *EECAA*, s.v.
Entwistle 1994
C. Entwistle, 'Pilgrim token with a stylite', in D. Buckton (ed.), *Byzantium: Treasures of Byzantine Art and Culture from British Collections*, London, 1994, no. 129.
Entwistle 1998
C. Entwistle, 'Byzantinische Handels-, Münz- und Glasgewichte', in L. Wamser and G. Zahlhaas (eds), *Rom und Byzanz. Archäologische Kostbarkeiten aus Bayern* (Katalog zur Ausstellung der Prähistorischen Staatssammlung München, 20. Oktober 1998 bis 14. Februar 1999), Munich, 1998, 153–65.
Entwistle 2003
C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003
Entwistle and Adams 2011
C. Entwistle and N. Adams (eds), *Gems of Heaven: Recent Research on Engraved Gemstones in Late Antiquity c. AD 200–600* (British Museum Research Publication 177), London, 2011.
Exhibition catalogue 1994
I Goti (Milano, Palazzo Reale 28 gennaio – 8 maggio 1994), Milan, 1994.
Finney 1994
P.C. Finney, 'Senicianus' Ring', *BJbb* 194 (1994), 175–96.
Finney 1997
P.C. Finney, 'Cross', *EEC*, s.v.
Finney 2003
P.C. Finney, 'Abbé James Hamilton: antiquary, patron of the arts, Victorian Anglo-Catholic', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003, 190–8.
Finney forthcoming
P.C. Finney, 'Concordia', *EECAA*, s.v.
Finney forthcoming
P.C. Finney, 'Concordia Apostolorum', *EECAA*, s.v.
Finney forthcoming
P.C. Finney, 'Horn of Plenty', *EECAA*, s.v.
Finkbeiner and Sakal 2010
U. Finkbeiner and F. Sakal (eds), *Emar after the Closure of the Tabqa Dam. The Syrian-German Excavations 1996–2002. Volume 1: Late Roman and Medieval Cemeteries and Environmental Studies* (Subartu XXV), Turnhout, 2010.
Fol 1875
W. Fol, *Catalogue du Musée Fol, vol. II: Antiquités: Glyptiques et verrerie*, Geneva, 1875.
Forien de Rochesnard 1978
J. Forien de Rochesnard, *Album des poids antiques. Vol. 3: Rome et Byzance*, Paris, 1978.
Fossing 1929
P. Fossing, *The Thorvaldsen Museum, Catalogue of the Antique Engraved Gems and Cameos*, Copenhagen, 1929.
Foy and Nenna 2001
D. Foy and M.-D. Nenna, *Tout feu, tout sable. Mille ans de verre antique dans le Midi de la France. Musée d'Histoire de Marseille*, Aix-en-Provence, 2001.
Foy 2009
D. Foy, 'Les apports de verres de Mediterranée orientale, en Gaule méridionale, au IVe et Ve siècles ap. J.-C.', *Annales du 17e Congrès de l'Association Internationale pour l'Histoire du Verre, Anvers, 2006*, Antwerp, 2009, 121–9.
Freestone 2002
I.C. Freestone, 'Composition and affinities of glass from the furnace on the island site, Tyre', *JGS* 44 (2002), 67–77.
Freestone and Gorin-Rosen 1998
I.C. Freestone and Y. Gorin-Rosen, 'The great glass slab at Bet She'arim, Israel: an early Islamic glassmaking experiment?', *JGS* 41 (1998), 105–16.
Freestone, Gorin-Rosen and Hughes 2000
I.C. Freestone, Y. Gorin-Rosen and M.J. Hughes, 'Primary glass from Israel and the production of glass in Late Antiquity and the Early Islamic period', in M.-D. Nenna, *La route du verre. Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen Âge*, Lyon, 2000, 65–83.
Freestone, Jackson-Tal and Tal 2008
I.C. Freestone, R.E. Jackson-Tal and O. Tal, 'Raw Glass and the production of glass vessels at Late Byzantine Apollonia-Arsuf, Israel', *JGS* 50 (2008), 67–80.
Freestone, Price and Cartwright 2009
I.C. Freestone, J. Price and C.R. Cartwright, 'The batch: its recognition and significance', *Annales du 17e Congrès de l'Association Internationale pour l'Histoire du Verre, Anvers, 2006*, Antwerp, 2009, 130–4.
Freestone, Ponting and Hughes 2002
I.C. Freestone, M. Ponting and M.J. Hughes, 'The origins of Byzantine glass from Maroni Petrera, Cyprus', *Archaeometry* 44/2 (2002), 257–72.
Freestone and Stapleton 2013
I.C. Freestone and C.P. Stapleton, 'Composition, technology and production of coloured glasses from mosaic vessels of the Early Roman Empire', in J. Bayley, I.C. Freestone and C. Jackson (eds), *Glass of the Early Roman Empire*, Oxford, forthcoming 2013.
Fremersdorf 1975
F. Fremersdorf, *Antikes, islamisches und mittelalterliches Glas* (Catalago del Museo Sacro, vol. V), Vatican City, 1975.
Froehner 1903
W. Froehner, *Collection Julien Gréau: Verrerie antique*, Paris, 1903.
Gager forthcoming
J.G. Gager, 'Amulet', *EECAA*, s.v.
Garbsch and Overbeck 1989
J. Garbsch and B. Overbeck, *Spätantike zwischen Heidentum und*

Christentum (Ausstellung der München Prähistorischen Staatsammlung München), Munich, 1989.

Garrucci 1880
R. Garrucci, *Storia dell'arte cristiana*, vol. 6, Prato, 1880.

Gasparri 2009
C. Gasparri, 'Un tesoro recuperate. Gemme, vetri e lavori in pietra dura da una collezione private', in G.S. Chiesa and E. Gagetti (eds), *Aquileia e la glittica di età ellenistica e romana*, Trieste, 2009, 281–92.

Gentili 1967
G.V. Gentili, 'Les poids monétaires en verre byzantins, byzantino-arabes et arabes provenant des fouilles de la villa romaine de Piazza Armerina', *Annales du 4e Congrès Internationale d'Etude Historique du Verre. Ravenne-Venise, 13–20 mai 1967*, Liège, 1967, 133–40.

Gesztelyi 1991
T. Gesztelyi, 'Spätrömische Glasbullen', *Acta Classica Universitatis Scientiarum Debreceniensis* 27 (1991), 107–14.

Gesztelyi 1994
T. Gesztelyi, 'Die Erforschung des pannonischen Schmucks seit Paulovics', *Acta Classica Universitatis Scientiarum Debreceniensis* 30 (1994), 73–82.

Gesztelyi 1996–7
T. Gesztelyi, 'Kettős csatornóyú üvegkameök ('Glaskameen mit zwei kanälen')', *Archaeologiai Értesítő* 123–4 (1996–7), 63–74.

Gesztelyi 1998
T. Gesztelyi, 'Spätrömische Glaskameen mit zwei kanälen', *Acta Antiqua Academiae Scientiarum Hungaricae* 38 (1998), 129–36.

Gesztelyi 2000
T. Gesztelyi, *Antike Gemmen im Ungarischen Nationalmuseum* (Catalogi Musei Nationalis Hungarici: Series Archaeologia III), Budapest, 2000.

Gesztelyi 2001a
T. Gesztelyi, 'Késő antik üvegkameó függők', *Balácai Közlemények* 6 (2001), 231–40.

Gesztelyi 2001b
T. Gesztelyi, 'Spätrömische Gemmenfunde in Pannonien', *Budapest Régiségei* 34 (2001), 109–16.

Giovannini 2010
A. Giovannini, 'Pendenti in vetro di forma circolare. Spunti di ricerca dagli esemplari del Museo Archeologico di Aquileia e dei Civici Musei di Storia ed Arte di Trieste', *Pallas. Revue d'Études Antiques: Glyptique romaine. Le public et son mirroir. Varia*, 83 (2010), 117–41.

Gonen 1997
R. Gonen, *Jewelry through the Ages at the Israel Museum*, Jerusalem, 1997.

Goodenough 1951
E.R. Goodenough, 'Review of Campbell Bonner, *Studies in Magical Amulets*', *American Journal of Philology* (1951), 308–16.

Goodenough 1953
E.R. Goodenough, *Jewish Symbols in the Graeco-Roman Period. Vol. 3: Illustrations* (Bollingen Series XXXVII), New York, 1953.

Gopkalo 2008
O.B. Gopkalo, *Busy i podveski chernyakhovskoi kultury*, Kiev, 2008.

Gorin-Rosen 1995
Y. Gorin-Rosen, 'Hadera, Bet Eli'ezer', *Excavations and Surveys in Israel* 13 (1995), 42–3.

Gorin-Rosen 1998
Y. Gorin-Rosen, *Ancient Glass from the Holy Land*, Fine Arts Museum of San Francisco and Israel Antiquities Authority, San Francisco, 1998.

Gorin-Rosen 2000
Y. Gorin-Rosen, 'The ancient glass industry in Israel: summary of the finds and new discoveries', in M.-D. Nenna, *La route du verre. Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen Âge*, Lyon, 2000, 49–63.

Gorin-Rosen and Winter 2010
Y. Gorin-Rosen and T. Winter, 'Selected Insights into Byzantine Glass in the Holy Land', in J. Drauschke and D. Keller (eds), *Glass in Byzantium – Production, Usage, Analyses* (Römisch-Germanisches Zentralmuseum Mainz, Tagungen 8), Mainz, 2010, 165–81.

Gorov, Lazarov and Tchimbouleva 1967
G. Gorov, M. Lazarov and J. Tchimbouleva, *Musée Archéologique de Bourgas Filiales à Nessebre et Sozopol* (Collection des Musées de Bulgarie), Sofia, 1967.

Gratuze 1988
B. Gratuze, *Analyse non destructive d'objets en verre par des méthodes nucléaires: application à l'étude des estampilles et poids monétaires islamiques*, Nouvelle Thèse d'Université, Orleans, 1988.

Greifenhagen 1975
A. Greifenhagen, *Schmuckarbeiten in Edelmetall* (Staatliche Museen Preußischer Kulturbesitz. Antikenabteilung. Band I), Berlin, 1975.

Grierson and Mays 1982
P. Grierson and M. Mays, *Catalogue of the Late Roman Coins in the Dumbarton Oaks Collection and in the Whittemore Collection: From Arcadius and Honorius to the Accession of Anastasius*, Washington DC, 1982.

Grote 1992
U. Grote, *LIMC* VI (1992), s.v. Nike (Hellenistischer Zeit), 881–95, 902–4.

Gundel 1925
W. Gundel, *RE* 12.2 (1925), 1975–8.

Habas 2011
L. Habas, 'A glass pendant decorated with the binding of Isaac in the Hecht Museum Collection', *Michmanim* 23 (2011), 47–58 (Hebrew); 51*–2* (English abstract).

Haeverninck 1974
T.E. Haeverninck, 'Trilobitenperlen', *Folia Archaeologica* 25 (1974), 105–29.

Halleux and Schamp 1985
R. Halleux and J. Schamp, *Les lapidaires grecs*, Paris, 1985.

Halsberghe 1972
G.H. Halsberghe, *The Cult of Sol Invictus*, Leiden, 1972.

Hamburger 1968
A. Hamburger, 'Gems from Caesarea Maritima', *'Atiqot* (English Series) 8 (1968), 1–37.

Hampel 1905
J. Hampel, *Alterthümer des frühen Mittelalters in Ungarn*, 3 vols, Braunschweig, 1905.

Harding 1950
G.L. Harding, 'A Roman family vault on Jebel Jofeh, Amman', *QDAP* 14 (1950), 81–94.

Harley and Viellfon forthcoming
F.J. Harley and L. Viellfon, 'Shepherd', *EECAA*, s.v.

Hartal 2005
M. Hartal, *Land of the Ituraens: Archaeology and History of Northern Golan in the Hellenistic, Roman and Byzantine Periods* (Golan Research Institute), Qasrin, 2005 (in Hebrew).

Henig 1975
M. Henig, *The Lewis Collection of Engraved Gemstones in Corpus Christi College, Cambridge*, Oxford, 1975.

Henig 1978
M. Henig, *A Corpus of Roman Engraved Gemstones from British Sites: Part ii: Catalogue and Plates* (British Archaeological Reports 8 [ii]), Oxford.

Henig 1994
M. Henig, *Classical Gems. Ancient and Modern Intaglios and Cameos in the Fitzwilliam Museum, Cambridge*, Cambridge, 1994.

Henig and Whiting 1987
M. Henig and M. Whiting, *Engraved Gems from Gadara in Jordan: the Sa'd Collection of Intaglios and Cameos*, Oxford, 1987.

Hermary, Cassimatis and Vollkommer 1986
A. Hermary, H. Cassimatis and R. Vollkommer, 'Eros. Part IV: Eros et le monde animal', *LIMC* 3.1 (1986), 850ff.

Hirschfeld and Peleg 2006
Y. Hirschfeld and O. Peleg, 'A glass pendant from Tiberias', *Israel Exploration Journal* 56/2 (2006), 201–8.

Hobbs *et al.* 2011
R. Hobbs, with contributions by J. Swaddling, J. Graham-Campbell and S. Marzinzik, 'The 'William Allen Box': a Victorian gentleman's collection of antiquities and curios', *The Antiquaries Journal* 91 (2011), 283–321.

Hoey Middleton 1998
S. Hoey Middleton, *Seals, Finger Rings, Engraved Gems and Amulets in the Royal Albert Memorial Museum, Exeter*, Exeter, 1998.

Hölscher 1990
T. Hölscher, 'Concordia', *LIMC* V.1 (1990), s.v.

Hopfner 1921–4
Th. Hopfner, *Griechisch-Ägyptischer Offenbarungszauber*, Leipzig, 1921–4 (rp Amsterdam, 1974).

Ihm 1992
C. Ihm, *Die Programme der christlichen Apsismalerei*, Stuttgart, 1992.
Iliffe 1934
J.H. Iliffe, 'Rock-cut tomb at Tarshihā. Late IV cent. A.D.', *QDAP* 3 (1934), 9–16.
Israeli 2003
Y. Israeli, *Ancient Glass in the Israel Museum: the Eliahu Dobkin Collection and Other Gifts*, The Israel Museum, Jerusalem, 2003.
Israeli and Mevorah 2000
Y. Israeli and D. Mevorah, *Cradle of Christianity*, The Israel Museum, Jerusalem, 2000.
Kahil and Icard 1984
L. Kahil and N. Icard, 'Artemis', *LIMC* II (1984), s.v.
Katsnelson 2002
N. Katsnelson, 'Excavations at Khirbet el-Shubeika: the glass ornaments', in Z. Gal (ed.), *Eretz Zafon. Studies in Galilean Archaeology*, Jerusalem, 2002, 322–31.
Keller 1909–13
O. Keller, *Die antike Tierwelt*, Leipzig, 1909-13, vol. 2, 470–9.
Keller and Lindblom 2008
D. Keller and J. Lindblom, 'Glass finds from the church and chapel', in Z.T. Fiema and J. Frösén, *Petra – The Mountain of Aaron. The Finnish Archaeological Project in Jordan. Volume 1: The Church and the Chapel*, Helsinki, 2008, 331–68.
Koch and Sichtermann 1982
G. Koch and H. Sichtermann, *Römische Sarkophage*, Munich, 1982.
Kotansky 1991
R. Kotansky, 'Incantations and prayers for salvation on inscribed Greek amulets', in C.A. Faraone and D. Obbink (eds), *Magika Hiera*, New York, 1991, 107–37.
Kornbluth 1994/5
G. Kornbluth, 'Early Byzantine crystals: an assessment', *Journal of the Walters Art Gallery* 52/3 (1994/5), 23–32.
Kozloff, Mitten and Sguaitamatti 1986
A.P. Kozloff, D.G. Mitten and M. Sguaitamatti, *More Animals in Ancient Art from the Leo Mildenberg Collection*, Mainz, 1986.
Krauskopf and Dahlinger 1988
I. Krauskopf and S.-C. Dahlinger, 'Gorgo', *LIMC* 4.1 (1988), 285–330.
Krug 1980
A. Krug, 'Antike Gemmen im Römisch-Germanischen Museum Köln', *Bericht der Römischen-Germanischen Kommission* 61 (1980), 151–260.
Kukai 1977
S. Kukai, *Persian Glass*, New York, Tokyo, Kyoto, 1977.
Lafontaine-Dosogne 1967
J. Lafontaine-Dosogne, *Itinéraires archéologiques dans la region d'Antioche. Recherches sur le monastère et sur l'iconographie de S. Syméon Stylite de Jeune*, Brussels, 1967.
Lányi 1972
V. Lányi, 'Die spätantike Gräberfelder von Pannonien', *Acta Archaeologia Academiae Scientiarum Hungaricae* 24 (1972), 53–313.
Latte 1960
K. Latte, *Römische Religionsgeschichte*, Munich, 1960.
Lehrer 1972
G. Lehrer, 'Three fragments of 'rare' glass from the Museum Collection', *Bulletin of Museum Haaretz Tel-Aviv* 14 (1972), 127–35.
Le Lasseur 1922
D. Le Lasseur, 'Mission archéologique a Tyr (Avril-Mai 1921)', *Syria* 3 (1922), 10–26.
Lees-Causey 1983
C. Lees-Causey, 'Some Roman glass in the J. Paul Getty Museum', *The J. Paul Getty Museum Journal* 11 (1983), 153–6.
Lerner 1977
J. Lerner, *Christian Seals of the Sasanian Period*, Istanbul, 1977.
Lommatsch 1903
E. Lommatsch (ed.), *P. Vegeti Renati Digestorum artis mulomedicinae libri*, Leipzig, 1903.
Lopez de la Orden
D. Lopez de la Orden, *La Gliptica de la Antiguedad en Andalucia*, Cadiz, n.d.
L'Orange and von Gerkan 1939
H.P. L'Orange and A. von Gerkan, *Der spätantike Bildschmuck des Konstantinsbogen*, Berlin, 1939.
Maaskant-Kleibrink 1975
M. Maaskant-Kleibrink, *Catalogue of the Engraved Gems in the Royal Coin Cabinet The Hague*, The Hague, 1978.
MacCormack 1981
S.G. MacCormack, *Art and Ceremony in Late Antiquity*, Berkeley, 1981.
Maguire 1995
H. Maguire (ed.), *Byzantine Magic*, Washington DC, 1995.
Magyar 2009
Z. Magyar, 'Trilobitenperlen from Dunaszekcső (Hungary)', *A Janus Pannonius Múzeum Évkönyve* (2009), 100–4.
Makhouly 1938
N. Makhouly, 'Rock-Cut Tombs at el-Jish', *QDAP* 8 (1938), 45–50.
Mandrioli Bizzarri 1987
A.R. Mandrioli Bizzarri, *La Collezione di Gemme del Museo Civico Archeologico di Bologna*, Bologna, 1987.
Mandruzzato 2008
L. Mandruzzato (ed.), *Vetri Antichi del Museo Archeologico Nazionale di Aquileia: Ornamenti e oggettistica di età romana, vetro pre- e post-romano*, Comitato nazionale italiano dell'AIHV, Trieste, 2008.
Marshall 1969
F.H. Marshall, *Catalogue of the Jewellery, Greek, Etruscan, and Roman, in the Departments of Antiquities, British Museum*, London, 1969.
Martiniani-Reber 2011
M. Martiniani-Reber (ed.), *Antiquités paléochrétiennes et byzantines. Collections du Musée d'art et d'histoire – Genève* (2 Collections byzantines du Mah – Genève), Geneva, 2011.
Maspero 1908
J. Maspero, 'Bracelets-amulettes d'époques byzantine', *Annales du Service des Antiquités de l'Egypte* 9 (1908), 246–58.
Mastrocinque 2011
A. Mastrocinque, 'The colours of magical gems', in C. Entwistle and N. Adams (eds), *Gems of Heaven: Recent Research on Engraved Gemstones in Late Antiquity, c. AD 200–600* (British Museum Research Publication 177), London, 2011, 62–8.
Matantseva 1994
T. Matantseva, 'Les amulettes byzantines contres le Mauvais Oeuil du Cabinet des Médailles', *JbAC* 37 (1994), 110–21.
Merkelbach 1995
R. Merkelbach, *Isis regina, Zeus Sarapis*, Stuttgart, 1995.
Merlat 1949
P. Merlat, 'Nouvelles images de Saint Syméon le Jeune', *Mélanges d' Archéologie et d'Histoire offerts á Charles Picard*, vol. II, Paris, 1949, 720–31.
Meyers forthcoming
C. Meyers, 'Lampstand [Jewish]', *EECAA*, s.v.
Michel 2001
S. Michel, *Die Magischen Gemmen im Britischen Museum* (P. and H. Zazoff [eds]), London, 2001.
Michel 2004
S. Michel, *Die Magischen Gemmen. Zu Bildern und Zauberformeln auf geschnittenen Steinen der Antike und Neuzeit*, Berlin, 2004.
Michel-von Dungern 2011
S. Michel-von Dungern, 'Studies on magical amulets in the British Museum', in C. Entwistle and N. Adams (eds), *Gems of Heaven: Recent Research on Engraved Gemstones in Late Antiquity c. AD 200–600* (British Museum Research Publication 177), London, 2011, 82–7.
Middleton 1891
J.H. Middleton, *The Engraved Gems of Classical Times with a Catalogue of the Gems in the Fitzwilliam Museum*, Cambridge, 1891.
Migotti 1999–2000
B. Migotti, 'Prilog poznavanju putova trgovine izmedu Dalmacije i Panonije', *Opuscula Archaeologica* 23–3 (1999–2000), 195–201.
Migotti *et al.* 1998
B. Migotti, M. Šlaus, Z. Dukat and L. Perinić, *Accede ad Certissiam: Antički i ranokršćanski horizont arheološkog nalazišta Štrbinci kod Dakova*, Zagreb, 1998.
Milne 1933
J.G. Milne, *Catalogue of the Alexandrian Coins in the Ashmolean Museum*, Oxford, 1933.
Mokary 2003
A. Mokary, 'Iskal', *Hadashot Arkheologiyot. Excavations and Surveys in Israel* (2003), 27 (English section) and 32–3 (Hebrew section).

Moustaka *et al.* 1992
A. Moustaka, A. Goulaki-Voutira and U. Grote, 'Nike', *LIMC* 6.1 (1992), 850–904.
Mouterde 1942–3
R. Mouterde, 'Objets magiques, Recueil S. Ayvaz', *Mélanges de l'Université Saint Joseph* 25 (1942–3), 105–28.
Nash 1968
E. Nash, *Pictorial Dictionary of Ancient Rome*, vol. I, London, 1968.
Naumann 1980
F. Naumann, *Antiker Schmuck* (Katalog der Staatlichen Kunstsammlungen Kassel, Nr 10), Kassel, 1980.
Nenna 2000
M.-D. Nenna, *La route du verre. Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen Âge*, Lyon, 2000.
Neuberg 1949
F. Neuberg, *Glass in Antiquity*, London, 1949.
Neugebauer 1975
O. Neugebauer, *A History of Ancient Mathematical Astronomy*, New York, 1975.
Nilsson 1955ff
M.P. Nilsson, *Geschichte der greichischen Religion*, Munich, 1955ff.
Nilsson 1961
M.P. Nilsson, *Geschichte der griechischen Religion* II, Munich, 1961.
Noll 1963
R. Noll, *Das römerzeitliche Gräberfeld von Salurn* (Archäologische Forschungen in Tirol II), Innsbruck, 1963.
Norden 1926
E. Norden, *P. Vergilius Maro. Aeneis Buch VI*, Leipzig and Berlin, 1926.
Nuzzo 2000
D. Nuzzo, 'Amulet and grave in late antiquity: some examples from Roman cemeteries', in J. Pearce, M. Millett and M. Struck (eds), *Burial, Society and Context in the Roman World*, Oxford, 2000, 249–55.
O'Hea 2001
M. O'Hea, 'Glass from the 1992–93 excavations', in Z.T. Fiema, C. Kanellopoulos, T. Waliszewski and R. Schick, *The Petra Church*, (P.M. Bikai, ed.), Amman, 2001, 370–6.
O'Hea 2013
M. O'Hea, 'V.6 The Glass', in K.D. Politis, *Sanctuary of Lot at Deir 'Ain 'Abata in Jordan: Excavations 1988–2003*, Amman, 2013, 293–315.
Opaiț 1984
Cr. Opaiț, 'Două amulete de sticlă din nordul Dobrogei', *Peuce* 9 (1984), 337–8.
Orsi 1912
P. Orsi, 'Byzantina Siciliae. VIII. Pesi in bronzo ed in vetro. Pendaglietti', *Byzantinische Zeitschrift* 21 (1912), 204–9.
Overbeck 1971
B. Overbeck, 'Zur Datierung einiger spätantiken Glaspasten', *Jahrbuch für Numismatik und Geldgeschichte* 21 (1971), 131–5.
Paoletti 1988
O. Paoletti, 'Gorgones Romanae', *LIMC* 4.1 (1988), 345–62.
Papanikola-Bakirtzi 2002
D. Papanikola-Bakirtzi (ed.), *Byzantine Hours. Works and Days in Byzantium* (Exh. cat., Thessaloniki, White Tower October 2001–January 2002), Athens, 2002.
Peleg 1991
M. Peleg, 'Persian, Hellenistic and Roman burials at Lohamei HaGeta'ot', *'Atiqot* 20 (1991), 131–52.
Peleg 2007
O. Peleg, 'A Glass Pendant', in E. Stern, *En-Gedi Excavations. I. Final Report (1961–1965)*, Jerusalem, 2007, 297–8.
Peña, Castellana and Fernández 1975
I. Peña, P. Castellana and R. Fernández, *Les Stylites syriens*, Milan, 1975.
Petrie 1888
W.M.F. Petrie, *Tanis. Part II. Nebesheh (Am) and Defenneh (Tahpanes)*, London, 1888.
Petrie 1914
W.M.F. Petrie, *Amulets*, London, 1914.
Phillip 1986
H. Phillip, *Mira et Magica*, Mainz, 1986.
Philippe 1970
J. Philippe, *Le monde byzantin dans l'histoire de la verrerie (Ve-XVIe siècle)*, Bologna, 1970.
Platz-Horster 1984
G. Platz-Horster, *Die antiken Gemmen im Rheinischen Landesmuseum Bonn*, Cologne, 1984.
Porat 1997
L. Porat, 'Quarry and burial caves at H. Kenes (Karmiel)', *'Atiqot* 33 (1997), 81–8 (in Hebrew; Eng. sum. at 15).
Preda 1980
C. Preda, *Callatis. Necropola romano-bizantină*, Bucharest, 1980.
Prausnitz 1986
M.W. Prausnitz, 'Remains of rediscovered synagogues in the Western Galilee in Kefar Yasif, Hanita and Mi'ilya', in M. Yedaya (ed.), *The Western Galilee Antiquities*, Tel Aviv, 1986, 461–5 (in Hebrew).
Price 1977
J. Price, 'Roman unguent bottles from Rio Tinto (Huelva) in Spain', *JGS* 19 (1977), 30–9.
Provoost 1976
A. Provoost, *Iconologisch onderzoek van de laat-antieke herdersvoorstellingen* (Proefschrift. Oudheidkunde en Kunstgeschiedenis. Katholieke Universiteit de Leuven), Leuven, 1976.
Rausa 1997
F. Rausa, 'Fortuna', *LIMC* 8.1 (1997), s.v.
Raynaud 2001
C. Raynaud, 'La verrerie de la nécropole du Verdier à Lunel Viel', in D. Foy and M.-D. Nenna, *Tout feu tout sable. Mille ans de verre antique dans le Midi de la France*, Aix-en-Provence, 2001, 215–16.
Rebourg 1990
A. Rebourg, 'La parure et la toilette', in *Vitrum: le verre en Bourgogne* (Catalogue d'exposition), Autun-Dijon, 1990, 103–35.
Rehren *et al.* 2010
Th. Rehren, F. Marii, N. Schibille, L. Stanford and C. Swan, 'Glass supply and circulation in early Byzantine southern Jordan', in J. Drauschke and D. Keller (eds), *Glass in Byzantium – Production, Usage, Analyses* (Römisch-Germanisches Zentralmuseum Mainz, Tagungen 8), Mainz, 2010, 65–81.
Reifenberg 1932
A. Reifenberg, 'Das antike zyprische Judentum und seine Bezeihungen zu Palästina', *Journal of the Palestine Oriental Society* 12 (1932), 209–15.
Richmond 1932
E.T. Richmond, 'A rock-cut tomb at Nazareth', *QDAP* 1 (1932), 53–4.
de Ridder 1909
A. de Ridder, *Collection De Clercq. Vol. 6: Les terres cuites et les verres*, Paris, 1909.
Riha 1990
E. Riha, *Der römische Schmuck aus Augst und Kaiseraugst* (Forschungen in Augst. Band 10), August 1990.
Rodenwaldt 1935
G. Rodenwaldt, 'Über den Stilwandel in der antoninischen Kunst', *Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin, Phil.-Hist. Klasse* 3 (1935), 1–27.
Rodenwaldt 1936
G. Rodenwaldt, 'Römische Löwen', *Critica d'arte* 1 (1936), 225–8.
Russell 19995
J. Russell, 'The archaeological context of magic in the Early Byzantine period', in H. Maguire (ed.), *Byzantine Magic*, Washington DC, 1995, 51–72.
Sabrosa 1996
A. Sabrosa, 'Necrópole romana do Porto dos Cacos (Alcochete)', *Ocupação Romana dos Estuários do Tejo e do Sado. Actas das I Jornadas sobre Romanização dos Estuários do Tejo e do Sado*, Lisbon, 1996, 283–300.
Sagi 1981
K. Sagi, *Das römische Gräberfeld von Keszthely-Dobogo*, Budapest, 1981.
von Saldern 1980
A. von Saldern, *Ancient and Byzantine Glass from Sardis* (Archaeological Exploration of Sardis Monograph 6), Cambridge (Mass.) and London, 1980.
Sale catalogue 1978
Coins and Antiquities Number 58. Coins and Antiquities Ltd 20/22 Maddox Street London W1, London, 1978.
Sale catalogue 1985
Ancient and Islamic Glass. Auction at the Hotel Drouot… 9, rue Drouot – 75009 Paris…, June 3, 1985 and June 4, 1985, Paris, 1985.

Sale catalogue 1989
Objects with Semitic Inscriptions 1100 BC–AD 700. Jewish, Early Christian and Byzantine Antiquities. Auktion XXIII Monday 20 November 1989 in Zurich. L. Alexander Wolfe Jerusalem. Frank Sternberg Zürich, Zurich, 1989.
Sale catalogue 1991
Antike Münzen...Auktion XXV Montag, den 25.November 1991 und Dienstag, den 26.November 1991 im Hotel Bellerive Au Lac, Zürich. Frank Sternberg AG – Zürich, Zurich, 1991.
Sale catalogue 1994
Antike Münzen....Antike Kleinkunst. Auktion XXVII. 7. und 8. November 1994 in Zürich. Frank Sternberg AG – Zürich, Zurich, 1994.
Sale catalogue 1996
Zoologica. Antiquarium, Ltd. Fine Ancient Arts Gallery, 948 Madison Avenue New York, NY 10021, New York, 1996.
Sale catalogue 2005
Antiken. Praekolumbische Kunst. Auktion 241 am 20., 21. und 22. September 2005. Gerhard Hirsch Nachfolger, München, Munich, 2005.
Sale catalogue 2006
Antiken. Auktion 243 am 14. Februar 2006. Gerhard Hirsch, Nachfolger, München, Munich, 2006.
Sale catalogue 2007
Christie's. New York. Ancient Jewelry. Thursday 6 December 2007, New York, 2007.
Sale catalogue 2012
Bonhams. Antiquities. Wednesday 23 May 2012…Knightsbridge, London, London, 2012.
Schauenburg 1953
K. Schauenburg, *Helios*, Berlin, 1953.
Schleiermacher 1984
M. Schleiermacher, *Römische Reitergrabsteine: die kaiserzeitlichen Reliefs des triumphierenden Reiters*, Bonn, 1984.
Schultze and Gudkova 2012
E. Schultze and A.V. Gudkova, 'A glass amulet from Nagornoe and the interpretation of pendants': *Poster_RAC_AOdruck-1.pdf*
Schumacher 1977
W.N. Schumacher, *Hirt und 'Guter Hirt'* (Römische Quartalschrift 34. Supplementheft), Rome, Freiburg, Vienna, 1977.
Schwabe and Reifenberg 1935
M. Schwabe and A. Reifenberg, 'Ein jüdisches Goldglas mit Sepulcralinschrift aus Rom', *Rivista di Archeologia Cristiana* 12 (1935), 341–6.
Schwartz 1999
J.H. Schwartz, 'Engraved gems in the collection of the American Numismatic Society II: Intaglios with Eros', *American Journal of Numismatics*, ser. 2, 11 (1999), 13–45.
Schwartz and Schwartz 1979
F.M. Schwartz and J.H. Schwartz, 'Engraved gems in the collection of the American Numismatic Society: Magical gems', *American Numismatic Society. Museum Notes* 24 (1979), 161–3.
Sena Chiesa 1966
G. Sena Chiesa, *Gemme del Museo nazionale di Aquileia*, Aquileia, 1966.
Sena Chiesa 1978
G.Sena Chiesa, *Gemme di Luna*, Rome, 1978.
Sena Chiesa 2002
G.Sena Chiesa (ed.), *Gemme dalla corte imperiale alla corte celeste*, Milan, 2002.
Sena Chiesa 2009
G.Sena Chiesa (ed.), *Gemme dei Civici Musei d'Arte Verona*, Rome, 2009.
Sena Chiesa and Gagetti 2009
G.Sena Chiesa and E. Gagetti (eds), *Aquileia e la glittica di età ellenistica e romana*, Trieste, 2009.
Small 1994
J.P. Small, 'Romulus and Remus', *LIMC* 7.1 (1994), 639–44.
Sodini forthcoming
J.-P. Sodini, 'Stylite', *EECAA*, s.v.
Sörries 2005
R. Sörries, *Daniel in der Löwengrube*, Wiesbaden, 2005.
Sörries forthcoming
R. Sörries, 'Daniel', *EECAA*, s.v.
Şovan 1987
O.L. Şovan,'Un mormînt cu medalioane romane de sticlă din necropola de la Mihălăşeni (jud. Botoşani)', *Arheologia Moldovei* 11 (1987), 227–34.
Spaer 1988
M. Spaer, 'The Pre-Islamic Glass Bracelets of Palestine', *JGS* 30 (1988), 51–61.
Spaer 2001
M. Spaer, *The Israel Museum, Jerusalem. Ancient Glass in the Israel Museum. Beads and Other Small Objects*, Jerusalem, 2001.
Spartz 1967
E. von Spartz, *Antike Gläser* (Kataloge der Staatlichen Kunstsammlungen Kassel Nr. 1), Kassel, 1967.
Spier 1993
J. Spier, 'Medieval Byzantine magical amulets and their tradition', *Journal of the Warburg and Courtauld Institutes* 56 (1993), 25–62.
Spier 2007
J. Spier, *Late Antique and Early Christian Gems*, Wiesbaden, 2007.
Stern 2001
E.M. Stern, *Roman, Byzantine and Early Medieval Glass: Ernesto Wolf Collection*, Ostfildern, 2001.
Stiegemann 2001
C. Stiegemann (ed.), *Byzanz. Das Licht aus dem Osten. Kult und Alltag im Byzantinischen Reich vom 4.bis 15. Jahrhundert* (Katalog der Ausstellung im Erbischöflichen Diözesanmuseum Paderborn vom 6. Dezember 2001 bis 31. März 2002), Paderborn and Mainz am Rhein, 2001.
Studer 2001
J. Studer, 'Les mosaïques animalières', in Z.T. Fiema *et al.*, *The Petra Church* (ed. P.M. Bikai), Amman, 2001, 306–27.
Stupperich 1986
R. Stupperich, 'Antiken der Sammlung W.W. VII. Gemmen', *Boreas: Münstersche Beiträge zur Archäologie* 9 (1986), 236–46.
Strus 2003
A. Strus, *Khirbet Fattir, Bet Gemal: two ancient Jewish and Christian sites in Israel*, Rome, 2003.
Tal, Jackson-Tal and Freestone 2004
O. Tal, R.E. Jackson-Tal and I.C. Freestone, 'New evidence for the production of raw glass at late Byzantine Apollonia-Arsuf, Israel', *JGS* 46 (2004), 51–66.
Tal, Jackson-Tal and Freestone 2008
O. Tal, R.E. Jackson-Tal and I.C. Freestone, 'Glass from a Late Byzantine secondary workshop at Ramla (South), Israel', *JGS* 50 (2008), 81–95.
Tam Tinh 1990
T. Tam Tinh, 'Isis', *LIMC* 5.1 (1990), s.v.
Tarn 1954
W.W. Tarn, *Cambridge Ancient History* 7, Cambridge, 1954, 701ff.
Tatcher and Gal 2011
A. Tatcher and Z. Gal, 'The ancient cemetery at Migdal Ha-'Emeq (El-Mujeidil)', *'Atiqot* 61 (2009), 1–47 (in Hebrew), 131–2 (Eng. sum.).
Tatton-Brown 1995
V. Tatton-Brown, 'Some Greek and Roman pendants and beads in the British Museum', in M. Rasmussen, U.L. Hansen and U. Näsman (eds), *Glass Beads. Cultural History, Technology, Experiment and Analogy. Proceedings of the Nordic Glass Bead Seminar, 16–18 Oct. 1992, Lejre*, Lejre, 1995, 37–43.
Tertullian
Tertullian, *CultFem* ii.10.4, ed. E. Kroyman, 1942.
Thraede 1994
K. Thraede, 'Homonoia', *RAC* 16 (1994), 235.
Toynbee 1973
J.M.C. Toynbee, *Animals in Roman Life and Art*, London, 1973.
Trzcionka 2007
S. Trzcionka, *Magic and the Supernatural in Fourth-Century Syria*, Abingdon and New York, 2007.
Tzaferis 1989
A. Tzaferis, *Excavations at Capernaum 1978–1982. Vol. I*, Winona Lake, Indiana, 1989.
Abu 'Uqsa 2005
H. Abu 'Uqsa, 'Migdal', *Hadashot Arkheologiyot – Excavations and Surveys in Israel* 117 (www.hadashot-esi.org.il).
Uscatescu 2004
A. Uscatescu, 'El vidrio romano y tardoromano del sector denominado Casa I de Iesso (Guissona, Lérida). Campaña de 1999', in A. Fuentes (ed.), *Jornadas sobre el vidrio en la España Romana*, La Granja, 2004, 33–61.

Veyries 1884
M.A. Veyries, *Les figures criophores dans l'art grec, l'art gréco-romain et l'art chrétien*, Paris, 1884.
Vikan 1995
G. Vikan, 'Icons and icon piety in Early Byzantium', in C. Moss and K. Kiefer (eds), *Byzantine East, Latin West. Art-Historical Studies in Honor of Kurt Weitzmann*, Princeton, 1995, 569–76.
Villard 1997
L. Villard, 'Tyche', *LIMC* 8.1 (1997), 115ff.
Vollenweider 1979
M.-L. Vollenweider, *Catalogue raisonné des sceaux, cylindres, intailles et camées. Vol II: les portraits, les masques de théatre, les symboles politiques* (Musée d' Art et d'Historique de Genève), Mainz, 1979.
Vollkommer 1997
R. Vollkommer, 'Victoria', *LIMC* 8.1 (1997), 237–68.
Walter 2003
C. Walter, *The Warrior Saints in Byzantine Art and Tradition*, Aldershot, 2003.
Wamser 2004
L. Wamser (ed.), *Die Welt von Byzanz – Europas östliches Erbe – Glanz, Krisen und Fortleben einer tausendjährigen Kultur* (Exh. cat., Archäologische Staatssammlung München – Museum für Vor- und Frühgeschichte, München vom 12.10.2004 bis 3.4.2005), Munich, 2004.
Wamser and Zahlhaas 1998
L. Wamser and G. Zahlhaas (eds), *Rom und Byzanz. Archäologische Kostbarkeiten aus Bayern* (Katalog zur Ausstellung der Prähistorischen Staatssammlung München, 20.Oktober 1998 bis 14.Februar 1999), Munich, 1998.
Warmenbol 2006
E. Warmenbol (ed.), *La Caravane du Caire, L'Egypte sur d'autres rives* (Exh. cat., Musée de l'Art wallon, Liège), Liège, 2006.
Weigel 1992
R. Weigel, 'Lupa Romana', *LIMC* 6.1 (1992), s.v.
Weiller 1980
R. Weiller, 'Intailles antiques découvertes au Grand-Duché de Luxembourg', *Publications de la Section Historique de l'Institut Gr.-D. de Luxembourg* 94 (1980), 199–262.
Weinstock 1958
S. Weinstock, 'Victoria', *RE* 8.A.2 (1958), 2501–42.
Wentzel 1962
H. Wentzel, 'Die 'Croce del re Desiderio' in Brescia und die Kameen aus Glas und Glaspaste im frühen und hohen Mittelalter', in *Stucchi e mosaici alto medievali* (Atti dell'ottavo congresso di studi sull'arte dell'alto Medievo, Verona – Vicenza – Brescia, 1959, Vol. I, *Lo stucco – Il mosaico – Studi vari*, Milan, 1962, 303–20.
Westenholz 2000
J.G. Westenholz (ed.), *Images of Inspiration. The Old Testament in Early Christian Art*, Bible Lands Museum Jerusalem, Jerusalem, 2000.
Whitehouse 2003
D. Whitehouse, *Roman Glass in The Corning Museum of Glass. Volume Three*, Corning Museum of Glass, New York, 2003.
Wulff 1909
O. Wulff, *Altchristliche und mittelalterliche byzantinische und italienische Bildwerke. Teil I: Altchristliche Bildwerke*, Berlin, 1909.
Zouhdi 1978
B. Zouhdi, 'Médaillons-pendentifs en verre du Musée National de Damas', *Annales du 7e Congrès de l'Association Internationale pour l'Histoire du Verre. Berlin-Leipzig 15–21 Aout 1977*, Liège, 1978, 51–65.
Zazoff 1983
P. Zazoff, *Die antiken Gemmen*, Munich, 1983.
Zwierlein-Diehl 1992
E. Zwierlein-Diehl, *Magische Amulette und andere Gemmen des Instituts für Altertumskunde der Universität Köln*, Opladen, 1992.

Chapter 16
A Scientific Study of Late Antique Glass Pendants in the British Museum

Stefan Röhrs, Andrew Meek and Chris Entwistle

Introduction

Thirty-eight glass pendants dating from the 4th to 6th century were studied using scanning electron microscopy with energy dispersive X-ray analysis (SEM-EDX). The aim of this study was to determine the chemical composition of the glass used to make these pendants and to see how it relates to previously analyzed glasses of similar date. This information will be used to inform our understanding of the manufacture of the pendants, the trade in glass in this period and the organization of production.

Primary glass production in the Byzantine period is believed to have been centred in the eastern Mediterranean on the Levantine coast and in northern Egypt. These glasses were produced using a sodium-rich mineral form of alkali, known as natron, and beach sands. This results in a glass with a low magnesium and potassium composition and geochemical signatures derived from the sands used.[1]

The glass produced in this period is very homogenous as glass production techniques were maintained without major changes. Therefore compositional differences observed in glasses are small. Nevertheless, it has been possible to identify compositional groups which reflect production methods (**Table 1**). The first four of these compositional groups can be linked to production sites on the Levantine coast or Egypt. A fifth type of glass known as HIMT (with high contents of iron, manganese and titanium) can be identified which, based on the current state of knowledge, is believed to have been produced in northern Egypt.[2] Previously published studies have suggested that the raw glass from these primary production sites was exported to secondary production sites where it was used to produce artefacts.[3] The results of the compositional analyses of finished glass objects from this period are therefore likely to reflect the primary production site of the glass, rather than the location where the objects themselves were formed.

The 'coloured Roman' glass composition has been taken from the analysis of the 88 green to blue coloured glass fragments found on the wreck Iulia Felix.[4] It has been suggested that the glass fragments from the bottles and vessels found on board the wreck were intended for glass recycling and that they cannot be attributed at the moment to a primary glass production site or sites.

In this paper, 38 Byzantine glass pendants from a group of 90 in the British Museum collection[6] were studied (**Table 2**). The selected pendants exhibit the range of provenances, iconography and glass colours present in the British Museum collection. With one exception, all the pendants are of translucent glass and only cat. no. 87 is opaque (**Table 2**). The pendants date from the 4th to 6th century and the majority were found in, or acquired from, different sites in the eastern Mediterranean area, or are of unknown origin. However, two of the pendants (cat. nos 6 and 22) were found in northwest Europe, England and France respectively.

Some of the pendants form groups based on their manufacturing technique, colour and iconography.[7] It was hoped that the chemical analyses undertaken would provide further information about how these groups are linked. For example, if pendants are found to have been produced by the same technique from glass with very similar

Table 1 Previously published compositional types of natron-based glass from the first millennium AD[5]

Type	Site/wreck	SiO_2	Na_2O	K_2O	CaO	MgO	Al_2O_3	FeO	MnO
Levantine I	Apollonia	70.6	15.2	0.71	8.07	0.63	3.05	0.35	<0.1
Levantine II	Beit Eli'ezer	74.9	12.1	0.46	7.16	0.63	3.32	0.52	<0.1
Egypt I	Wadi Natrun	66.5	21.4	0.34	3.7	0.9	2.7	1	<0.1
Egypt II	Ashmunein	68.2	15	0.2	10.8	0.5	2.1	0.7	0.2
HIMT	Carthage	64.8	18.7	0.44	5.24	1.29	3.18	2.07	2.66
Coloured Roman	Iulia Felix	69.9	16.7	0.59	7.20	0.61	2.42	0.46	0.45

Table 2 Pendants selected for analysis

Catalogue number	Registration number	Provenance	Colour
03	PE 1983,1108.52	Unknown	blue
06	PE 2007,8045.224	Braughing, England	amber
12	ME 1867,0915.109	Jerusalem (?)	green
18	GR 1871,0616.35	Egypt	amber
19	PE 1895,1219.1	Palestine	amber
20	PE 1896,0616.1	Unknown	pale yellow
22	GR 1917,0601.2944	Amiens, France	blue-green
26	PE 1983,1108.50	Unknown	blue-green
27	ME running number 102945	Unknown	blue-green
28	PE 1983,1108.47	Unknown	yellow
30	PE 1983,1108.48	Unknown	amber
31	PE1881,0719.33	Alexandria, Egypt	amber
32	PE1883,0621.16	Egypt	brown
34	PE 1871,0123.10	Cyprus (?)	blue
35	PE 1871,0123.11	Cyprus (?)	blue
38	GR 1884,0509.7	Unknown	blue
39	GR 1884,0509.8	Syria (?)	light green
40	GR 1887,0706.12	Amrit, Syria	light green
45	PE 1983,1108.57	Unknown	brown
47	ME 1908,0615.15	Hebron, Palestine	amber
59	GR 1872,0726.33	Unknown	turquoise
62	GR 1871,0123.9	Cyprus	brown
65	GR 1883,0621.14	Egypt	amber
66	GR 1887,0706.9	Beirut, Lebanon	green
67	GR 1887,0706.9	Beirut, Lebanon	green
68	GR 1887,0706.9	Beirut, Lebanon	green
69	GR 1874,0716.6	Egypt	blue
70	GR 1889,0706.9	Beirut, Lebanon	blue
71	GR 1887,0706.9	Beirut, Lebanon	blue
75	ME 1908,0615.16	Hebron, Palestine	olive green
78	GR 1883,0621.13	Unknown	blue
82	GR 1863,0709.98	Unknown	amber
83	PE 1983,1108.60	Unknown	amber
86	PE 1889,0706.91	Tyre, Lebanon	brown
87	PE 1983,1108.61	Unknown	opaque turquoise
88	PE 1882,0510.35	Unknown	green
89	PE 1875,0522.3	Unknown	light green
90	PE 1891,0512.14	Unknown	light blue

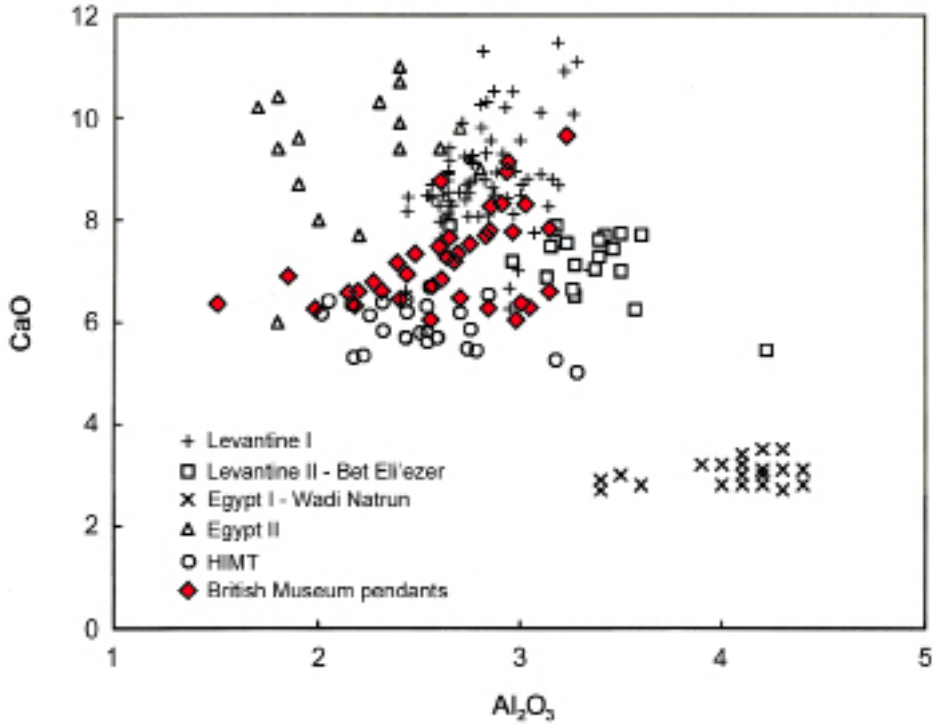


Figure 1 Plot of wt% aluminium oxide (Al_2O_3) against calcium oxide (CaO) after Freestone[9] with data from Gratuze[10] and Brill[11] compared to this study

compositions and iconography, it seems reasonable to believe that they were produced in the same workshop.

Analytical method

Variable pressure (VP) scanning electron microscopy with energy dispersive X-ray analysis (SEM-EDX) was carried out on the reverse side of the pendants. A Hitachi S3700N equipped with an Oxford instruments INCA x-act detector was used. The chamber pressure was 40 Pa to conduct the charge away from the sample. All measurements were carried out at a working distance of 10.0mm, a voltage of 20 kV and a live time of between 150 and 300 seconds. The pendants were not sampled as they fit easily into the sample chamber of the SEM and no coating was needed for the analysis in VP conditions.

The surface of the selected objects was polished with 6µm diamond paste to remove the weathered surface of the glass as this crust would influence the analytical results. A rotating tool with a felt tip wetted with industrial methylated spirits (IMS) was used to apply the polishing paste and a small area (1–2mm in diameter) was cleaned. Images were taken to record the cleaned spots. The objects were mounted in the SEM with the cleaned area as horizontal as possible to avoid geometric effects which would alter the X-ray spectra. This analytical method resulted in detection limits for most metal oxides of around 0.1 wt%.

Quantitative analysis under VP conditions is more problematic than under vacuum as the electron beam spreads out due to the collision with the remaining gas particles in the chamber. For imaging in VP conditions this spread is negligible as only a small fraction of particles is diverted, but for analysis this halo of electrons around the main electron beam can lead to spectral information coming from other areas than those intended. Tests under various pressures have confirmed the main spectral information does come from the area the beam is focused on. The beam spread can lead to weak signals (about 10% of the total counts) picked up from areas some 100µm from the focal spot. However, this effect is negligible for the analysis of homogeneous areas which are relatively large like the cleaned areas on the pendants examined here, which are some hundred µm to about 1mm across.

Results and discussion

Glass composition

All the pendants are made from soda-lime-silica glass and show low magnesium and potassium contents typical of glass made from a sodium-rich mineral known as natron. The colourants used in the glasses include iron (also a ferri-sulphide chromophore[8]), copper and cobalt. The only pendant produced from opaque glass was found to contain antimony, showing that calcium antimonate was used as an opacifier. **Table 3** presents the results of the VP-SEM-EDX analysis.

The transparent coloured pendants can be divided into four compositional groups. Comparing these groups to results from the literature shows that three groups are close in composition to compositional groups named Levantine I, HIMT and 'coloured Roman' glass.[12] The similarities found are unsurprising as the glass group reported as Levantine I and HIMT are Roman-Byzantine glasses produced in the Levant and Egypt from around the 4th to the 7th century. These compositional groups are the successors of the typical 'Roman glass' whose manufacture and distribution comes to an end somewhere before the middle of the first millennium AD. Other reported production groups from Egypt (I and II)[13] match the composition of the pendants less well (see **Figure 1**, **Tables 1** and **4**). When production of Egypt I starts is not clear but it is associated with Islamic glass production as its

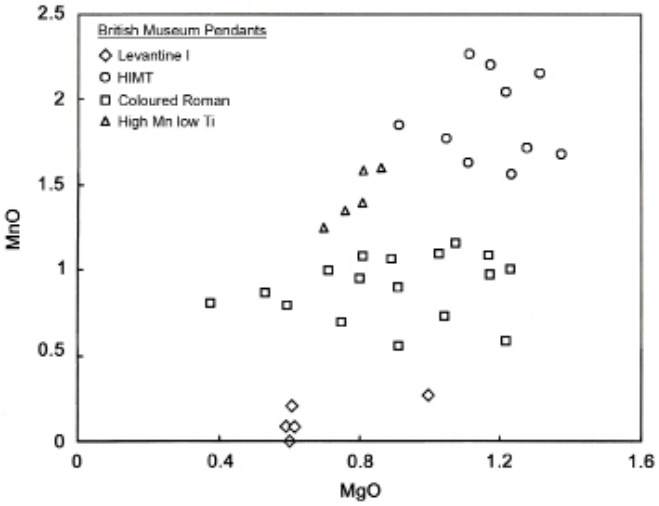


Figure 2 Plot of wt% manganese oxide (MnO) against magnesium oxide (MgO) for the translucent British Museum pendants only

composition is derived from Islamic glass weights, which were first introduced by Abd al-Malik in AD 692; its production comes to an end in the 8th century.[14] Egypt II is associated with the 8th to 9th century. Therefore these are later than the glass pendants. The fourth pendant group is characterized by 'High Mn and low Ti' contents and is not matched by a recognized glass compositional group. Average values for each of these groups are presented in **Table 4**.

Figure 2 shows how these four pendant groups vary in terms of the manganese and magnesium contents. The glass in the Levantine I group has a low manganese and magnesium content, but also a low titanium content (TiO_2 < 0.2 wt%). The low manganese content (MnO< 0.3 wt%) suggests that manganese was not added intentionally to the glass batch. The HIMT glass, as its abbreviation suggests, is characterized by a higher content of iron, manganese and titanium, but also a high magnesium content is typical (**Table 1**). The glass of this group has higher contents of MgO (> 0.9 wt%), TiO_2 (> 0.13 wt%) and MnO (> 1.5 wt%) than the glass of the other groups.

The 'coloured Roman' glass group falls between the Levantine I and HIMT groups in **Figure 2**. The levels of manganese (which averages 0.8 wt% in this study) in the samples of this group suggest that this was an intentional addition. This may have originally been added as a decolourizer to counteract the colouring effects of iron present in these glasses when they were originally produced. However, iron then appears to have been intentionally added to many of these glasses to colour them brown, amber or yellow. Iron is even present in high quantities in some of the blue pendants in this group. It may have been added unintentionally to these glasses as part of the cobalt-rich material used to colour them.[15]

The glass composition of the pendants in the group labelled 'High Mn low Ti' does not match the other compositional groups reported in the literature (see **Tables 1** and **4**). The manganese and iron contents are high (MnO> 1.2 wt%, FeO> 0.9 wt%) but the magnesium and titanium contents (MgO< 0.9 wt%, TiO_2 < 0.2 wt%) are too low to fit into the HIMT group. This group might be the result of the mixing/recycling of glass of different compositions (possibly HIMT and coloured Roman, see **Figure 2**).

The one opaque pendant (cat. no. 87) analyzed has probably been opacified with calcium antimonate, which is the typical opacifier of this period. The titanium and manganese oxide contents are low so the base glass of this pendant is probably best matched by the Levantine I glass composition despite the high magnesium content of 1.14 wt% which might be introduced together with the opacifier.

In general the high iron content of the pendants is even higher than the content reported for the compositional groups in the literature.[16] Some pendants of a yellow/amber/brown or blue colour have particularly high iron contents. Values of up to 5.9 wt% FeO were found in individual pendants in the HIMT and 'coloured Roman' groups. This holds true too for the copper content in the glass of many of the blue and green pendants which is also unusually high with values of 1.6 to 3.6 wt% CuO (see **Table 1**). This might be explained by the desire to make the pendants from glass of a strong/dark colour which necessitated the addition of large quantities of colourants such as iron and copper. Less coloured glass would appear more transparent.

Regional groups

The discovery of a range of compositions within this set of objects suggests that the glass used to produce them was obtained from various primary production locations. This finding fits with the pattern of Late Antique glass production organization discussed in the introduction to this paper; i.e. the primary production of the glass is a separate procedure from the secondary production of the pendants themselves.[17]

There are no patterns in the data to suggest any link between the composition of the glass and the provenance of the pendants except the connection to the eastern Mediterranean region. For example, those pendants which were found in areas bordering the eastern Mediterranean coast (Israel, Palestine, Lebanon and Syria) fall into all four compositional groups (see **Figure 3**).[18] The two pendants (cat. nos 6 and 22) which were found in north-western Europe have similar compositional characteristics to many of the pendants with provenances in the eastern Mediterranean region (see **Figure 4**).[19] They are made from HIMT and 'coloured Roman' glass respectively; this and the fact that only a few pendants have been found in this region makes it probable that they were imported to north-western Europe as finished products.[20]

Colour groups

The colours of the pendants are also not strongly linked to a particular compositional type. It can be suggested from the data that there is a link between blue/light-blue/blue-green pendants and the compositional group 'coloured Roman'. Nine out of the eleven pendants with these colours are found in this compositional group. It is possible, therefore, that this composition was favoured by the workshop colouring the glass. However, if this was occurring elsewhere, it does not mean that the workshop producing the pendants can be linked to this choice. Also, the glass fragments from the Iulia Felix shipwreck were in the blue/light-blue/blue-green range, so there is evidence that a glass of this composition and colour was traded in the first half of the 3rd century at least.

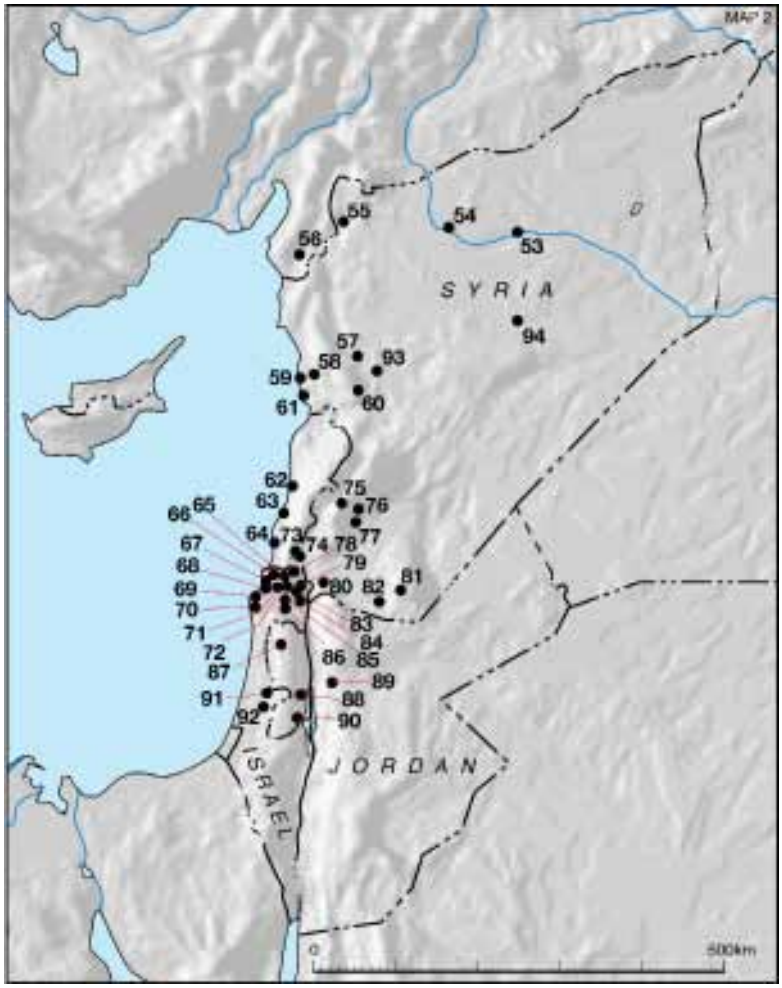
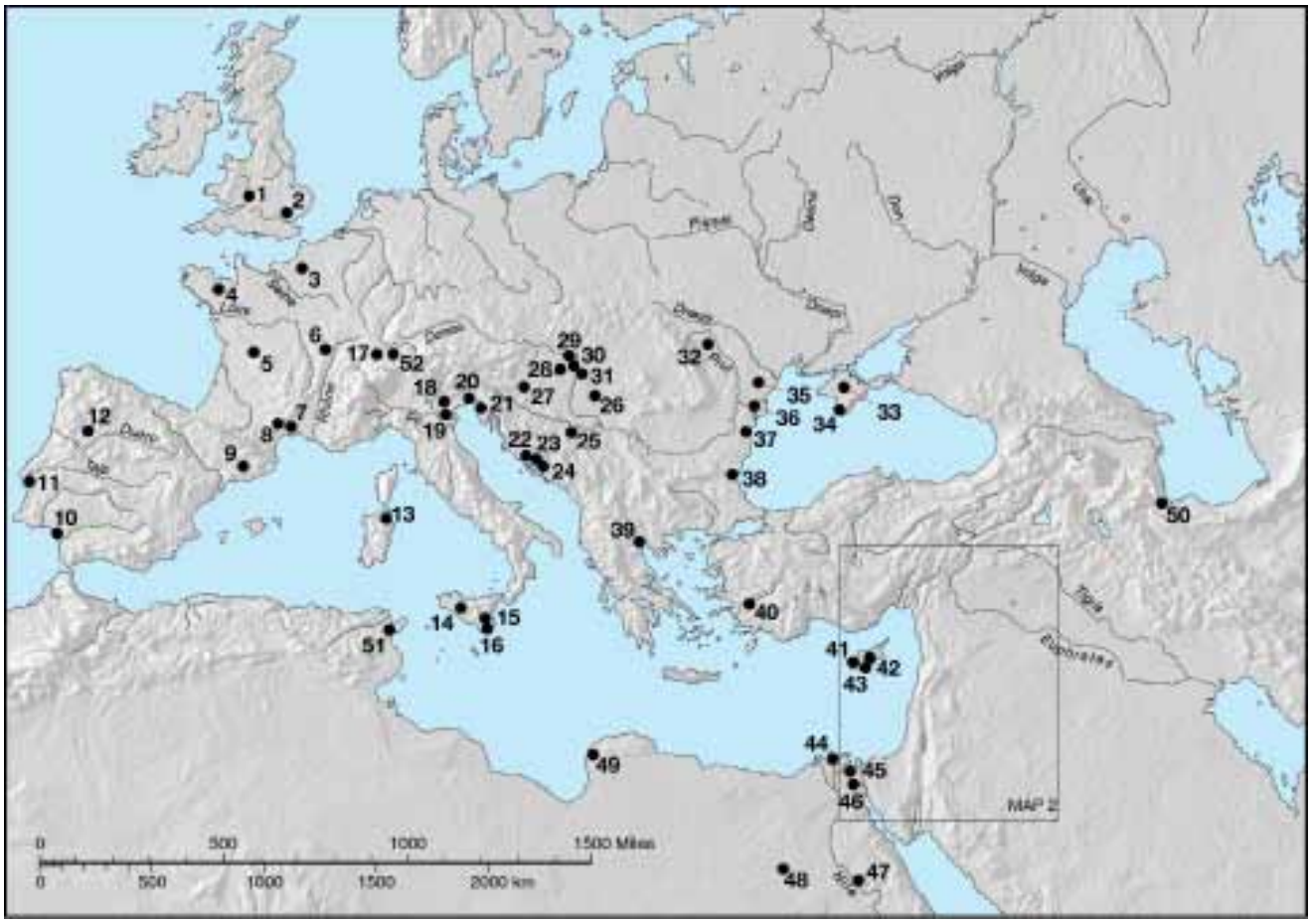


Figure 3 Distribution map of the findspots in the Levant region for pendants from the British Museum collection and other published collections. For the key see note 21

Figure 4 Distribution map of the findspots in Europe and around the Mediterranean Sea for pendants from the British Museum collection and other published collections. For the key see note 22



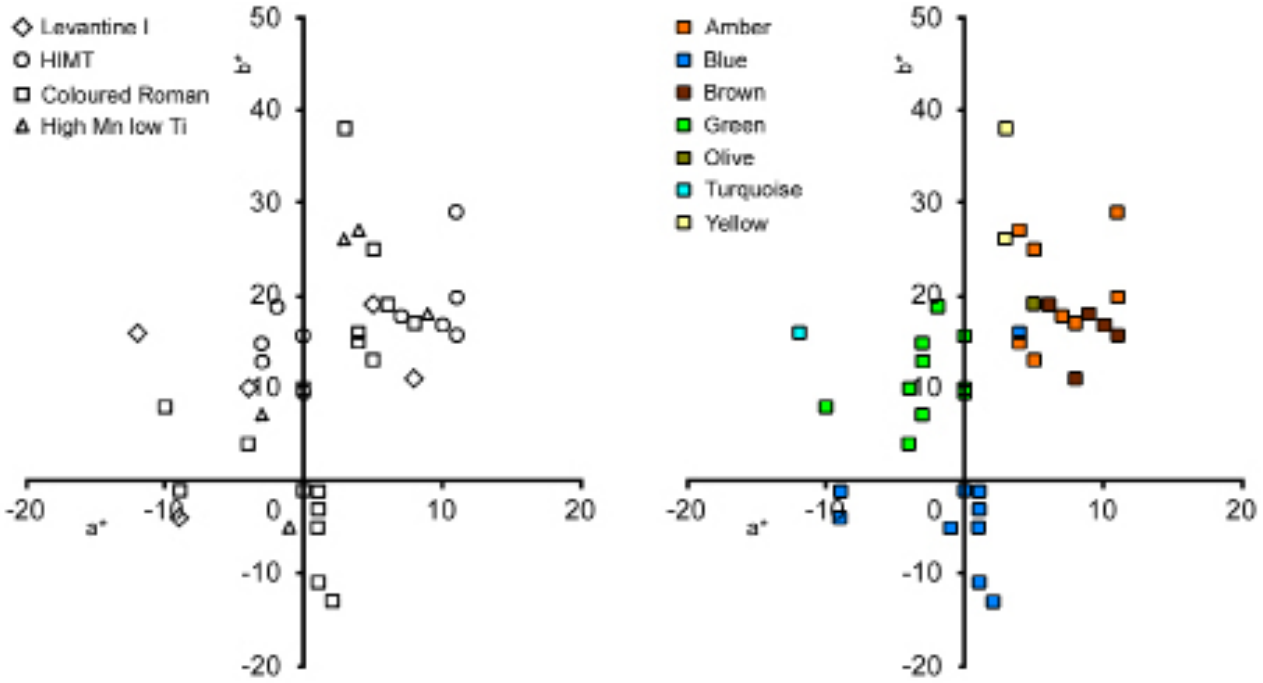


Figure 5 Bivariate plot of the colourimetric values a* and b* [25]

Another link might be between the amber/brown or green pendants and the HIMT compositional group. None of the ten HIMT pendants was blue, an observation shared in other studies.[23] The Levantine I group consisted of several colours from amber to olive, pale green, blue-green and turquoise. **Figure 5** shows the relation of colour and the compositional group. The values for the colour measurements are taken from and are explained in Appendix A in the preceding paper and relate to the CIE L*a*b* colour space.[24]

Workshop groups

Similarities in manufacturing methods and the use of the very same die on a small group of pendants might indicate that the pendants were made in the same workshop. The type of loop formation might also be a particular technique typical for a workshop or a regional variation of the manufacturing method. Twenty-one pendants in the British Museum's collection have been identified as having slightly larger and/or twisted loops. [26] Of this group 13 pendants have been analyzed: cat. nos 12, 34, 35, 38, 39, 40, 66–71 and 90. Among these are several pendants which share the same image made from the identical die: cat. nos 34 and 35 (Daniel and the lions); 38 and 39 (stylite saints); 66–8 (lion with a frontal face); 70 and 71 (another lion with a frontal face).[27] Two colours have been used for these nine pendants: blue and green. Analysis has shown that all the blue pendants are of the group 'coloured Roman' glass and the green ones have the HIMT glass composition. The four remaining pendants are made using different dies but at least two of them (cat. nos 40 and 69) are made from very similar glass: the green being HIMT, and the blue 'coloured Roman' (see **Figure 5**). The pendants 12 and 90 are made from a different glass and are also different in colour. Other examples of pendants made from the identical die are cat. nos 19 and 20. The motif of opposing male and female busts has been stamped into amber or pale yellow glass. Both pendants are made from 'coloured Roman' glass. Another group of pendants made from the same die are cat. nos 30–2 showing the standing shepherd-kriophoros. With regards to their loops, these do not belong to the group with larger and/or twisted loops. The colour range of these pendants is in the brown to amber range and the composition of the glass is HIMT for all three, which might suggest a common workshop background.

Most of the pendants made from the same die also share the same colour and glass type. However, this is not the case for cat. nos 38 and 39. Here a deliberate decision to make these pendants of differing colour, blue and green, might have led to the selection of the green HIMT type and blue 'coloured Roman' glass.

If the loop type and the use of the two blue and green glass compositions can be linked to one production place/time, it suggests that this workshop was employing two glass types giving two different colours and utilizing at least five different dies: besides those listed above, one can probably associate cat. no. 40 (a stylite saint, an unidentified figure and a cross) and cat. no. 69 (another lion with frontal face) with this supposed grouping because of their similar loops and glass composition. However, the production of other pendants made from alternative glass types and stamped with different dies were produced at the same workshop (which was perhaps obtaining its glass from more than one or two primary production locations) cannot be excluded.

Iconographic groups

Some aspects of the various iconographic groups have been addressed in the preceding section where those pendants made from the same dies have been discussed in the context of workshop groupings. Further associations of iconographic groups including the same motifs stamped by different dies with glass compositional groups are difficult to make. To

give an example: cat. no. 28 with the motif of the standing shepherd-kriophoros can be compared to the shepherd-kriophoros group cat. nos 30–2 (colour range: amber-brown made from HIMT glass). Cat. no 28 does not match the group as it is yellow and made from glass of the 'high Mn low Ti'-group. Another example of the same iconography and different glass composition are cat. nos 82 and 83 both showing a ram and a star and made from amber coloured glass. The glass composition is, however, different.

The only instance of a group of pendants with the same iconography, apart from those made from the same die, with a matching glass composition is cat. nos 26 and 27. These pendants, stamped with Christ and the apostles, are both blue-green in colour and of the 'coloured Roman' glass type.

Conclusions

The compositional analysis of the glass pendants allows them to be divided into groups which can be related to their place of primary production. Seventeen pendants are made from 'coloured Roman' glass (**Table 5**). Five pendants were made from a glass composition not matched by another recognized group. Fifteen of the glass pendants are produced from glass which was very likely made from raw materials in the eastern Mediterranean area, probably on the Levantine coast and northern Egypt. This does not necessarily imply that the pendants were produced in this area, only that the glass used to make them was produced there. Considering this and the large number of pendants found in the Levant region it seems likely that most of the pendants, including those found in western Europe, were produced somewhere in the eastern Mediterranean region. However secondary production elsewhere from Roman or eastern Mediterranean glass cannot be ruled out.

This study shows that coloured glass of Roman composition was still used in the 4th century and was also employed for a few pendants dating from the 5th and 6th centuries. Glass of the compositions Levantine I and HIMT were in parallel use at the same time (see **Table 5**). This can be interpreted in two ways: either the primary production sites for these glass types were in use contemporaneously, or that Roman glass was still being recycled.

The colours of the pendants seem to be approximately linked to particular glass types. In the 'coloured Roman' group blue hues dominate and for the HIMT glass only green to brown colours are observed. For the groups Levantine I and 'high Mn low Ti' no preference in colour was found. The workshop groups characterized by the type of loop formation have preferentially used HIMT and 'coloured Roman' glass. For this sub-group the composition can be linked to the colour: the green being HIMT and the blue 'coloured Roman'. However, it is interesting to note that the level of iron and copper in some of the pendants is particularly high, when compared to similar published glasses. This is probably related to a desire to produce the pendants from strongly coloured glasses.

Where iconographic groups for the pendants have been found, it is sometimes possible to observe compositional similarities within these groups. This is normally the case, when pendants are die-linked. In one case (cat. nos 38 and 39) the same die has been used in different glass types, probably to obtain a variation in colour. This suggests that the workshops producing these pendants were obtaining their glass from multiple sources. These glasses may be recycled or newly imported glass, or a combination of the two. To what extent the pendant workshops in their capacity as secondary production sites have altered the glass composition remains unclear. The high concentration of the colourants iron and copper separates the glass used for the pendants from common vessel glass. Such adaptation in the colour of the glass might possibly have been carried out at a secondary production site.

Some of the similarities between the pendants based on their manufacturing technique, colour and iconography are mirrored in their glass compositions. This suggests that at least some of the pendants share the same origin. Where the workshops responsible for the production of these pendants were situated remains unclear. However, it is clear that their main sources of glass were of typical Roman composition or other glass compositions which were made by primary glass production sites from the eastern Mediterranean area.

Table 3 VP SEM EDX results of the glass pendants

Cat. No.	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	MnO	FeO	CoO	CuO	SnO_2	Sb_2O_3	PbO	Compositional Group
3	16.38	0.62	1.99	67.68	<0.1	0.25	1.50	0.37	6.28	0.11	<0.1	0.76	<0.1	3.56	<0.1	<0.1	0.29	Levantine I
6	17.75	0.91	2.85	62.39	0.10	0.32	0.90	0.67	6.30	0.18	1.85	5.31	<0.1	<0.1	0.16	0.17	0.12	HIMT
12	17.97	0.81	2.33	64.65	<0.1	0.39	1.26	0.58	6.64	<0.1	1.58	3.22	<0.1	<0.1	0.13	<0.1	<0.1	High Mn low Ti
18	14.54	0.70	2.62	65.37	0.12	0.16	1.36	0.65	8.78	0.10	1.25	0.88	<0.1	2.79	<0.1	<0.1	0.69	High Mn low Ti
19	18.17	1.03	2.65	63.89	<0.1	0.44	1.15	0.47	7.28	0.13	1.10	3.42	<0.1	<0.1	<0.1	<0.1	0.12	Coloured Roman
20	19.04	1.17	2.62	63.80	<0.1	0.49	1.01	0.55	6.83	<0.1	0.98	2.75	<0.1	<0.1	0.10	0.10	<0.1	Coloured Roman
22	18.59	0.80	3.07	66.63	<0.1	0.38	1.04	0.54	6.33	0.17	0.95	0.89	<0.1	<0.1	0.30	<0.1	0.27	Coloured Roman
26	18.22	1.04	2.21	64.33	0.29	0.36	1.51	0.71	6.64	0.18	0.74	0.95	<0.1	1.73	0.48	0.21	0.43	Coloured Roman
27	18.52	1.22	2.28	64.37	0.16	0.34	1.34	0.72	6.81	0.10	0.59	0.91	<0.1	1.69	0.20	0.13	0.35	Coloured Roman
28	18.96	0.87	2.57	64.34	0.12	0.43	1.08	0.63	6.75	0.13	1.60	2.30	<0.1	<0.1	0.18	<0.1	<0.1	High Mn low Ti
30	16.44	1.23	2.69	62.67	0.13	0.36	0.80	0.59	7.33	0.23	1.56	5.53	<0.1	<0.1	0.12	0.12	<0.1	HIMT
31	10.23	1.37	2.85	67.20	0.10	0.35	0.87	0.96	7.85	0.28	1.68	5.88	<0.1	<0.1	0.16	<0.1	0.11	HIMT
32	16.87	1.11	2.49	62.14	0.16	0.48	0.98	0.64	7.35	0.13	1.63	5.68	<0.1	<0.1	0.11	0.10	<0.1	HIMT
34	16.49	0.89	2.97	64.78	<0.1	<0.1	1.28	0.62	7.79	<0.1	1.07	1.99	0.38	0.33	<0.1	<0.1	0.79	Coloured Roman
35	16.64	1.23	2.83	64.72	0.23	0.25	1.30	0.42	7.72	0.15	1.01	1.96	0.28	0.26	0.19	<0.1	0.81	Coloured Roman
38	17.17	0.38	1.86	67.52	<0.1	0.47	1.48	0.50	6.93	<0.1	0.81	1.45	0.17	<0.1	0.22	0.20	0.48	Coloured Roman
39	17.26	1.31	3.15	62.98	<0.1	0.34	1.11	0.76	7.84	0.38	2.15	2.37	<0.1	<0.1	<0.1	<0.1	0.10	HIMT
40	18.45	1.11	2.71	64.11	<0.1	0.41	1.24	0.43	6.48	0.49	2.26	2.09	<0.1	<0.1	<0.1	<0.1	<0.1	HIMT
45	18.52	1.17	2.68	63.45	<0.1	0.38	1.26	0.46	7.23	<0.1	1.09	3.24	0.10	<0.1	<0.1	<0.1	0.12	Coloured Roman
47	19.16	1.07	2.40	63.43	<0.1	0.42	1.19	0.45	7.15	0.17	1.16	3.08	<0.1	<0.1	0.18	<0.1	0.10	Coloured Roman
59	18.54	0.60	1.51	68.06	0.17	0.13	1.77	0.38	6.39	<0.1	<0.1	0.37	<0.1	2.12	<0.1	<0.1	<0.1	Levantine I
62	17.73	0.81	2.19	63.96	<0.1	0.30	1.31	0.53	6.34	0.20	1.40	4.97	<0.1	<0.1	<0.1	<0.1	<0.1	High Mn low Ti
65	17.33	0.91	2.76	66.86	<0.1	<0.1	1.53	0.77	7.55	<0.1	0.56	0.46	0.12	<0.1	0.54	0.28	<0.1	Coloured Roman
66	18.12	1.28	3.15	63.99	<0.1	0.10	1.21	0.68	6.63	0.54	1.72	1.55	0.12	<0.1	0.21	0.39	<0.1	HIMT
67	18.16	1.22	2.99	64.88	0.10	0.12	1.34	0.57	6.09	0.51	2.04	1.70	<0.1	<0.1	0.16	<0.1	<0.1	HIMT
68	17.95	1.17	3.01	64.67	0.18	0.23	1.24	0.52	6.36	0.58	2.20	1.69	<0.1	<0.1	<0.1	<0.1	<0.1	HIMT

Table 3 continued

69	16.03	0.71	3.04	65.64	<0.1	0.30	1.03	0.92	8.35	0.27	1.00	1.73	<0.1	0.23	0.17	<0.1	0.12	Coloured Roman
70	16.10	0.53	2.95	66.20	<0.1	0.18	1.04	0.87	8.96	0.16	0.87	1.43	<0.1	0.24	<0.1	<0.1	0.14	Coloured Roman
71	17.93	0.75	2.86	65.42	<0.1	0.27	1.11	0.83	8.30	0.12	0.70	1.08	<0.1	0.11	0.28	<0.1	0.10	Coloured Roman
75	16.63	1.00	2.95	66.63	0.13	0.10	1.29	0.59	9.12	0.20	0.27	0.46	<0.1	0.12	<0.1	0.28	<0.1	Levantine I
78	15.11	0.76	2.92	67.92	<0.1	0.37	1.00	0.69	8.34	0.13	1.35	0.88	0.17	0.12	0.20	<0.1	<0.1	High Mn low Ti
82	16.00	1.05	2.44	63.80	<0.1	0.51	1.14	0.73	7.02	0.27	1.77	4.61	<0.1	<0.1	0.24	<0.1	<0.1	HIMT
83	18.17	0.91	2.41	63.20	<0.1	0.44	1.17	0.53	6.45	0.20	0.90	5.28	<0.1	<0.1	0.12	<0.1	<0.1	Coloured Roman
86	19.71	0.59	2.66	66.10	<0.1	0.53	1.40	0.62	7.67	<0.1	<0.1	0.34	<0.1	<0.1	<0.1	<0.1	<0.1	Levantine I
87	21.72	1.14	2.56	59.49	<0.1	0.59	1.19	0.55	6.05	<0.1	0.12	0.83	<0.1	2.72	0.47	2.22	0.15	Opaque
88	18.75	0.81	2.16	66.18	<0.1	0.32	1.46	0.56	6.59	<0.1	1.08	0.81	<0.1	0.74	<0.1	0.31	<0.1	Coloured Roman
89	15.17	0.61	3.24	67.84	0.15	<0.1	1.04	1.08	9.66	0.10	0.20	0.49	<0.1	<0.1	0.15	<0.1	0.17	Levantine I
90	18.47	0.60	2.61	66.17	0.14	0.24	1.38	0.56	7.52	0.11	0.80	0.88	<0.1	0.11	<0.1	<0.1	0.28	Coloured Roman

Table 4 Average VP-SEM-EDX results of each of the compositional groups found

Group		**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**Cl**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**FeO**	**CoO**	**CuO**	**SnO_2**	**Sb_2O_3**	**PbO**
Levantine I	Average (n=5)	17.29	0.68	2.47	67.26	0.09	0.20	1.40	0.61	7.82	0.09	0.13	0.48	0	1.16	0.03	0.06	0.09
	s.d.	1.62	0.16	0.63	0.76	0.07	0.18	0.24	0.26	1.38	0.07	0.1	0.15	-	1.44	0.06	0.11	0.12
HIMT	Average (n=10)	16.72	1.18	2.83	63.88	0.08	0.32	1.08	0.66	6.92	0.36	1.89	3.64	0.03	0.01	0.11	0.08	0.04
	s.d.	2.29	0.13	0.24	1.42	0.07	0.13	0.18	0.14	0.61	0.15	0.24	1.80	0.05	0.03	0.09	0.12	0.05
Coloured Roman	Average (n=17)	17.84	0.89	2.61	65.09	0.06	0.31	1.25	0.62	7.32	0.12	0.90	1.90	0.08	0.33	0.16	0.07	0.25
	s.d.	0.99	0.24	0.33	1.30	0.09	0.14	0.17	0.15	0.71	0.07	0.18	1.24	0.11	0.54	0.16	0.11	0.25
High Mn low Ti	Average (n=5)	16.86	0.79	2.52	65.25	0.05	0.33	1.20	0.62	7.37	0.13	1.44	2.45	0.03	0.59	0.10	0	0.15
	s.d.	1.73	0.06	0.25	1.41	0.06	0.09	0.14	0.06	0.99	0.04	0.14	1.54	0.07	1.1	0.09	-	0.27

Table 5 Cat. nos by composition type

Levantine I	HIMT	'Coloured Roman'	High Mn low Ti
3	6	19*	12
59	30*	20*	18
75	31*	22	28
86	32*	26	62
89	39*	27	78
	40	34*	
Total 5	66*	35*	Total 5
	67	38* (with HIMT 39)	
	68*	45	
	82	47	
		65	
	Total 10	69	
		70*	
		71*	
		83	
		88	
		90	
		Total 17	

* = stamped with a die which has also been used for another pendant
On the balance of the extensive archaeological evidence all of the pendants date to the 4th century, apart from:
Underlined numbers = 5th–6th century
Bold & underlined number = 6th century

Notes

1 I.C. Freestone, 'Glass production in Late Antiquity and the Early Islamic period: a geochemical perspective', in M. Maggetti and B. Messiga (eds), *Geomaterials in Cultural Heritage* (Geological Society, London, Special Publications, 257), London, 2006, 201–16.
2 I.C. Freestone, 'The provenance of ancient glass through compositional analysis', *Materials Research Society Symposium Proceedings* 852 (2005), 195–208.
3 I.C. Freestone, M. Ponting and M.J. Hughes, 'The origins of Byzantine glass from Maroni Petrera, Cyprus', *Archaeometry* 44(2) (2002), 257–72; Freestone (n. 2).
4 A. Silvestri, 'The coloured glass of Iulia Felix', *Journal of Archaeological Science* 35 (2008), 1489–501.
5 After I.C. Freestone (n. 2); T. Rehren, F. Marii, N. Schibille, L. Stanford and C. Swan. 'Glass supply and circulation in Early Byzantine Southern Jordan', in J. Drauschke and D. Keller (eds), *Glass in Byzantium – Production, Usage, Analyses*, Mainz, 2010, 65–81; with data from M.-D. Nenna, M. Picon and M. Vichy, 'Ateliers primaires et secondaires en Egypte à l' époque gréco-romaine', in M.-D. Nenna (ed.), *La route du verre. Ateliers primaires et secondaires du second millénaire av. J.-C. au Moyen Âge*, Lyon, 2000, 97–112.
6 See the catalogue in Entwistle and Finney, this volume.
7 Ibid.
8 See I.C. Freestone and C.P. Stapleton, 'Composition, technology and production of coloured glasses from mosaic vessels of the Early Roman Empire', in J. Bayley, I.C. Freestone and C. Jackson (eds), *Glass of the Early Roman Empire*, Oxford, forthcoming 2013; L.R. Green and F.A. Hart, 'Colour and chemical composition in ancient glass: an examination of some Roman and Wealden glass by means of ultraviolet-visible-infra-red spectrometry and electron microprobe analysis', *Journal of Archaeological Science* 14 (1987), 271–82.
9 I.C. Freestone, Y. Gorin-Rosen and M.J. Hughes, 'Primary glass from Israel and the production of glass in Late Antiquity and the Early Islamic period', in Nenna (n. 5), 65–83; Freestone (n. 2), 199.
10 B. Gratuze, *Analyse non destructive d'objets en verre par des méthodes nucléaires: application à l'étude des estampilles et poids monétaires islamiques*, Nouvelle Thèse d'Université, Orleans, 1988.
11 R.H. Brill, 'Scientific investigations of the Jalame glass and related finds', in G.D. Weinberg (ed.), *Excavations at Jalame: Site of a Glass Factory in Late Roman Palestine*, Columbia, 1988, 257–94.
12 See Freestone, Gorin-Rosen and Hughes (n. 9). See Freestone (n. 2); Silvestri (n. 4).
13 Nenna, Picon and Vichy (n. 5); Freestone, Gorin-Rosen and Hughes (n. 9)
14 Gratuze (n. 10); B. Gratuze and J.-B. Barrandon, 'Islamic glass weights and stamps: analysis using nuclear techniques', *Archaeometry* 23/2 (1990), 155–62.
15 See I.C. Freestone and C.P. Stapleton, 'Composition and technology of Islamic enamelled glass of the thirteenth and fourteenth centuries', in R. Ward (ed.), *Gilded and Enamelled Glass from the Middle East*, London, 1988, 122–7.
16 Freestone, Gorin-Rosen and Hughes (n. 9); Freestone (n. 2); Silvestri (n. 4); Nenna, Picon and Vichy (n. 5).
17 Freestone, Ponting and Hughes (n. 3); Freestone (n. 2).
18 Entwistle and Finney, this volume.
19 Ibid.
20 It still remains possible, however, that the pendants could have been made from this glass in northern Europe.
21 Entwistle and Finney, this volume.
Findspots/key to maps:
1. Droitwich, Worcestershire, England (1)
2. Braughing, Hertfordshire, England (1)
3. Amiens, France (1)
4. La Chapelle-des-Fougeretz, France (1)
5. Antigny, France (1)
6. Autun, France (1)
7. Lunel-Viel, France (1)
8. Saint André de Sangonis, France (1)
9. Guissona, Spain (1)

10. Huelva, Spain (1)
11. Porto dos Cacos, Alcochete, Portugal (1)
12. Idanha-a-Velha, Portugal (1)
13. Olbia, Sardinia (1)
14. Sicily (4)
15. Piazza Armerina, Sicily (1)
16. Acrae, Sicily (1)
17. Augst, Switzerland (1)
18. Bolzano-Gries, Italy (1)
19. Salorno, Italy (1)
20. Aquileia, Italy (17)
21. Trieste, Italy (13)
22. Kaštel Sućurac, Croatia (1)
23. Solin, Croatia (17)
24. Split, Croatia (unknown)
25. Dalmatia (2)
26. Štrbinci (Roman Certissia ?), Croatia (1)
27. Poetovio, Slovenia (1)
28. Keszthely-Dobogó, Hungary (2);
29. Baláca, Hungary (1)
30. Ságvár, Hungary (1)
31. Czikó, Hungary (1)
32. Mihălăşeni, Romania (3)
33. Crimea (unknown)
34. Chersonesos, Ukraine (1)
35. Nagornoe, Ukraine (1)
36. Tulcea, Romania (1)
37. Callatis, Romania (2)
38. Burgas, Bulgaria (1)
39. Thessaloniki, Greece (2)
40. Sardis, Turkey (1)
41. Cyprus (6)
42. Idalium, Cyprus (3)
43. Amanthus, Cyprus (1)
44. Alexandria, Egypt (1)
45. Defenneh, Egypt (2)
46. Gheyta, Egypt (1)
47. Akhmim Panopolis, Egypt (1)
48. Egypt (9)
49. Sidi Khrebish, Benghazi, Libya (1)
50. Gilan province, Iran (4)
51. Carthage, Tunisia (1)
52. Görbelhof (Rheinfelden), Switzerland (1)
53. Ar-Raqqah, Syria (1)
54. Emar, Syria (1)
55. Qal'at Seman, Syria (1)
56. Antioch, Turkey (2)
57. Hama, Syria (2)
58. Kefr Ra, Syria (3)
59. Tortosa, Syria (1)
60. Homs, Syria (2)
61. Amrit, Syria (1)
62. Beirut, Lebanon (8)
63. Sidon, Lebanon (1)
64. Tyre, Lebanon (8)
65. Tarshihā, Israel (8)
66. Khirbet el-Shubeika, Israel (1)
67. Nahariyya, Israel (unknown)
68. Lohamei HaGeta'ot, Israel (2)
69. Tel Shiqmona, Israel (2)
70. Kastra, Israel (2)
71. Karmiel, Israel (1)
72. Sajur, Israel (1)
73. Tel Dan, Israel (1)
74. Horshat Tal, Israel (unknown)
75. Kefr ez Zeit, Syria (2)
78. Gush Halav (unknown), Israel (2)
79. Capernaum, Israel (1)
80. Khisfin, Syria (1)
83. Migdal, Israel (3)
84. Tiberias, Israel (1)
85. Nazareth, Israel (3)
86. Migdal Ha Emeq, Israel (1)
87. Samaria/Sebaste, Israel (1)
88. Mount of Olives, Jerusalem, Israel (3)
89. Amman, Jordan (2)
90. En-Gedi, Israel (1)
91. Beit Gemal, Israel (1)
92. Bêt Jibrûn, Israel (4)
93. Selemiya, Syria (1)
94. Syria (unspecified; 7)

22 Ibid.

23 I.C. Freestone, R. Greenwood, Y. Gorin-Rosen, 'Byzantine and Early Islamic Glassmaking in the Eastern Mediterranean: Production and Distribution of Primary Glass', in G. Kordas (ed.), *Hyalos – Vitrum – Glass History, Technology and Conservation of Glass and Vitreous Materials in the Hellenic World*, Athens, 2002, 167–74.

24 See P. Fletcher in this volume.

25 One blue pendant (at a* = 4 and b* = 16) sits among the brown pendants, possibly the weathered surface of the pendant resulted in a brown value for the colour measurement.

26 Entwistle and Finney, this volume.

27 Ibid.

Chapter 17
The Production and Uses of Glass in Byzantine Thessaloniki

Anastassios Antonaras

Early Christian period

Glass working (Pl. 1)

The presence of glass workshops has been archaeologically attested in Thessaloniki during the Roman imperial period, especially in its later stages. These workshops, just like other installations that used naked flames, were obliged to be either outside the city walls or at the city's perimeter.[1] Although glass-working remains have been found in Thessaloniki's eastern necropolis, they have also been identified within the city walls, in abandoned public spaces such as the public bath house on top of which the mid-5th century Acheiropoietos basilica was erected, and on the site of the ancient Forum, where after the 5th and certainly during the 7th century artisans, potters, tanners, and metal smiths founded their workshops.[2] Several forms of vessels have been attributed to these local workshops. It seems that a few forms of unguentaria were already manufactured here in the late 1st century,[3] while in the 4th and 5th centuries, several forms of unguentaria, tableware, jugs, bottles, bowls and beakers, as well as lamps were produced in Thessaloniki (**Pl. 2**).[4]

Jewellery

With regards to non-vessel glass products made in Thessaloniki during the Early Christian period, glass was used for the production of complete pieces of jewellery or for the embellishment of metal objects. The majority of finds from the city can be dated from the late 3rd to the 6th century[5] and is comprised of pendants, beads both large and small – occasionally decorated, often plain – and spacers (**Pls 3–4**). A few 'black', mainly plain or occasionally ribbed, glass bracelets appear after the 3rd century, most probably imitating jet prototypes which were very much in fashion during the succeeding century.[6] Although almost no glass rings occur, glass pastes, almost exclusively plain ones, are found quite often both in cheaper and more expensive jewellery (**Pl. 5**). In addition, enamelling is sporadically found among the finds.[7]

Window panes

Unlike at other Macedonian sites, such as Philippi,[8] the use of glass window panes in Thessaloniki is rarely attested. Those few finds can be dated approximately to the 4th century,[9] and were manufactured either by the muff process or the cylinder technique.

Mosaics

Mosaic pavements

The similarities among mosaic pavements in their overall decorative display, in their particular motifs, and in their technique has lead to the assumption that there was a workshop of mosaicists in Thessaloniki, which most probably began to work on the buildings of the Emperor Galerius (r. AD 305–11) and established a tradition that continued throughout the 4th and into the early 5th century.[10] As for the use of glass tesserae, one observes in the few extant, mainly stone mosaic pavements of public buildings and private houses, that mainly light green, and

Plate 1 Glass vessels from Thessaloniki, 3rd–5th century. Museum of Byzantine Culture, Thessaloniki

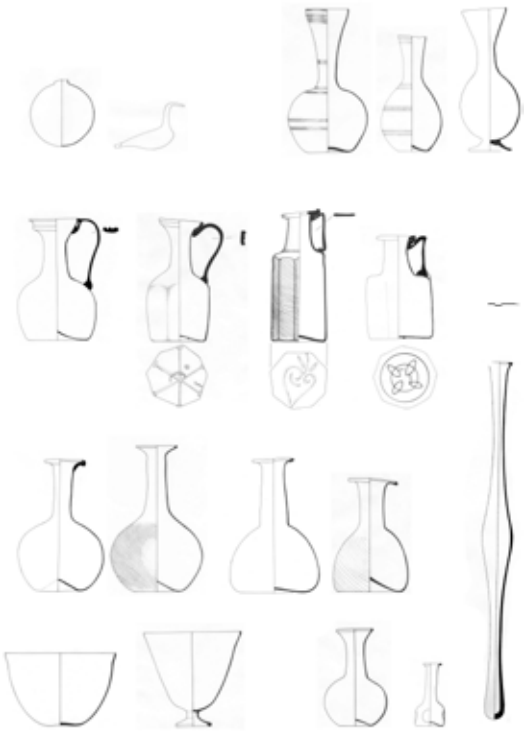


Plate 2 (left) Local products of Thessaloniki's glass workshops, 4th–6th century

Plate 3 (above left) Glass beads, 4th century. Museum of Byzantine Culture, Thessaloniki

Plate 4 (above right) Glass and stone necklace, 3rd–4th century. Museum of Byzantine Culture, Thessaloniki

less often yellow, green, orange, and red were only occasionally used in very small numbers from the 4th to the late 6th century.[11]

Wall mosaics

Thousands of square metres of wall mosaics have been preserved in the Rotunda, the basilicas of the Acheiropoietos and St Demetrios and the Latomou Monastery, as well as in other buildings,[12] which quite probably represent a fraction of the wall mosaics which once existed in Thessaloniki. An overview of works dating from the early 4th to the 7th century is preserved in them, representing an expressive idealistic naturalism in the early ones that gradually becomes more rigid with fewer nuances employed in the rendering of the comparatively simple and well-defined motifs.

The Rotunda[13]

The Rotunda is a vaulted building erected about AD 300 by the Caesar Galerius, as part of his palace, probably as a temple to his patron Zeus. It was converted into a Christian church at an early stage, probably by the time of Theodosius (r. AD 379–95), by adding a large barrel-vault and a semicircular apse to the east side of the building. It may possibly have been already decorated with mosaics as early as the reign of Constantine the Great (r. AD 306–37).[14]

The lower part, up to the base of the dome, was covered with a multi-coloured marble revetment. The upper part of the building was covered with mosaics dated to the 4th century. The execution of the mosaics was uniform in conception and design. For the compilation of the mosaics, blue, turquoise, yellow, green, red, purple, gold and silver

Plate 5 Gold ring with enamel, first half of the 4th century. Museum of Byzantine Culture, Thessaloniki

Plate 6 Detail of a martyr from the dome of the Rotunda, Thessaloniki, 4th century

glass tesserae were used along with grey and white stone ones. At a rough estimate, 13 tons of glass was used in the mosaic decoration.[15]

Three of the large lower barrel vaults are decorated with geometric patterns containing vases with fruits or flowers, birds and fruits, a wide field with a gold Latin cross on a silver field strewn with birds, stars and baskets with fruit. At the arched openings at the base of the dome, flowers, fruit, intersecting circles, fretwork, fish-scale patterns, and interlacing chain motifs are depicted.

The decoration of the dome is divided into three concentric bands. The lower, which is the best preserved, is divided into eight panels with a shared theme: a variety of elaborate architectural structures are placed against a gold background. In front of each panel two or three martyrs stand frontally accompanied by his name, status and the month of his feast (**Pl. 6**). The second and third bands are almost completely obliterated. On the lower part of the middle band, sandaled feet or the traces of feet of probably 24 or more figures survive on a green ground. The centre of the dome bore a representation of Christ in glory supported by four angels. The heads, hands and wings of three angels, the mythical phoenix and the aureole survive. Of the standing figure of Christ all that remains is the fingers of his right hand, part of his halo and the initial charcoal underdrawing on the masonry.

The Acheiropoietos[16]

The three-aisled mid-5th century basilica, which is today known as the Acheiropoietos, is decorated with 5th-century mosaics in the soffits of the colonnades on the ground floor and in the south gallery, on the western wall of the south gallery, on the tribelon arches, on the arches in the narthex, in the triple window in the west wall of the narthex and on the western wall of the southern chapel. The decorative subjects tend to be symbols or allegories of the Christian paradise and the triumph of Christianity. The mosaics are characterized by the lifelike portrayal of the natural motifs depicted in them. Blue, turquoise, peacock blue, 'black', yellow, green, red, purple, gold, and silver glass tesserae were used, along with amber, beige, olive green-beige and white stone ones.

On a gold ground, leafy branches, aquatic flowers and leaves, vines, and wreaths emerge from vases at the bases of the soffits (**Pl. 7**). The wreaths encircle a Christogram or a cross in an aureole, a circle or a disc. These representations are supplemented by birds, books, and vessels containing fish or fruit. There is also a certain amount of geometrical decoration, either combined with birds and pomegranates, or in the form of repeated motifs covering the whole of the available surface, like a fish-scale pattern, polygons or interlacing bands.

Latomou monastery[17]

The small church of St David was originally the katholikon of Latomou or the Latomon monastery constructed at the end of the 5th or the beginning of the 6th century. It is a square building, whose west side is now ruined, with an apse at the east end. The semi-dome of the apse bears a mosaic representation of the Vision of Ezekiel, a unique position for a theme of this nature. Christ Emmanuel is depicted in glory

Plate 7 Detail of floral mosaic, Church of the Acheiropoietos, Thessaloniki, 5th century

Plate 8 Detail of Christ, Latomou Monastery, Thessaloniki, late 5th–early 6th century

Plate 9 Detail of angels trumpeting above St Demetrios, Church of St Demetrios, Thessaloniki, 5th century

Plate 10 Detail of St Demetrios with clerics and St Sergios, Church of St Demetrios, Thessaloniki, 7th century

seated upon a multi-coloured arc (**Pl. 8**). Around the aureole are the symbols of the four Evangelists: an angel, eagle, lion and calf. In the left-hand corner the dumbfounded Prophet Ezekiel is portrayed on the banks of the River Chebar; its tributaries are the four rivers of Eden, all flowing from the feet of Christ. The Prophet Habakkuk, or possibly Isaiah, is in the right-hand corner. The composition is inscribed with a double band: a narrow interior one with a gold chain connecting oval and square gems, and an outer, wider one filled with palms and vessels flanked by swans. Dark blue, blue, turquoise, yellow, green, olive green, red, orange, purple, gold and silver glass tesserae were used in the composition, along with white, grey, and beige stone ones. The mosaic is dated to the end of the 5th or the beginning of the 6th century.

Agios Demetrios[18]

This five-aisled basilica with transept, originally built in the 5th and renewed in the 7th century, was almost entirely destroyed by fire in 1917. The same fire destroyed all the mosaics which decorated the south face of the small north colonnade, some of which are preserved and exhibited in the Museum of Byzantine Culture in Thessaloniki. Eleven panels of mosaics from the rest of the church survived, dating from the 5th to the 9th century. They are to be seen on the east façade of the wall dividing the narthex from the naos and on the two large sanctuary piers.

Parts of two 5th-century panels are preserved on the upper part of the west wall. On the south aisle is the dedication of two children to a devotional icon of the saint and, on the north aisle, two angels trumpeting above the saint (**Pl. 9**). Geometrical and floral motives are also preserved on the inner half of the arches of the windows of the western wall of the narthex, within the original glazing. From the 7th century, mosaics are preserved on the west wall of the nave, in the sanctuary, and on the two large sanctuary piers presenting St Demetrios alone, with children, clerics and city officials, and St Sergios (**Pl. 10**). On the south face

Plate 11 Gold glass tiles from the Church of St Demetrios, Thessaloniki, 6th–7th century. Museum of Byzantine Culture, Thessaloniki

Plate 12 Gold glass tiles, Church of St Demetrios, Thessaloniki, 6th–7th century

Plate 13 (above left) Glass crustae, Church of St Demetrios, Thessaloniki, 5th century

Plate 14 (above right) Middle Byzantine glass-working remains from Dioiketeriou Square, Thessaloniki. Museum of Byzantine Culture, Thessaloniki

Plate 15 (left) Middle Byzantine glass-working remains from 2 Agapis Street, Thessaloniki. Museum of Byzantine Culture, Thessaloniki

of the north-east pier there is a votive mosaic depicting the Virgin Mary orans with a warrior saint, probably Theodore. In the upper part of the picture is a bust of Christ blessing. This mosaic is dated to the 9th century.

Blue, turquoise, lavender, yellow, green, olive-green, khaki, red, gold, and silver glass tesserae were used in the construction of the mosaics, along with white, beige, pinkish beige and grey stone ones. It should also be noted that the plaster behind and among the gold tesserae was painted with an intense red colour. Glass has also been used for the wall decoration in the form of *opus sectilia*. Large triangular gold glass tiles, one with a curved stripe, and a few rectangular ones are preserved (**Pls 11–12**). They were probably used on the arches in the interior of the colonnades, still partly visible in the tribellum from the narthex to the main church, or on a flat wall. This type of decoration is generally dated to the 6th century and here it seems to represent one more example of the conservatism generally characteristic of 7th-century church decoration. Finally, flat pieces of greenish glass, cut in the appropriate forms, were also used as insets in the multi-coloured marble *opus sectile* decoration of the church, on the western wall of the central aisle, which is dated to the 5th century (**Pl. 13**).

Middle Byzantine period

Glass working

There are very few Middle Byzantine glass vessels from Thessaloniki and only a few pieces of glass jewellery consisting of simple beads and glass bangles. Yet glass working is one of the few artisanal activities that has been archaeologically attested in Thessaloniki. In the centre of the city, and contrary to legislation,[19] at least two glass workshops have been uncovered. The first, whose kiln has been excavated, is to the south-west of the basilica of St Demetrios and was apparently producing vessels including stemmed beakers and probably hanging lamps (**Pl. 14**).[20] The excavation of the second workshop, which was located just to the north-east of St Sophia, produced only small finds. Among the deformed masses a few more interesting items have been found: small parts of blue 'cakes' (*c.* 2cm thick) for the production of mosaic tesserae, colourless green and yellowish tesserae, obviously meant to be covered with gold or silver foil, and opaque green, turquoise, dark blue and purple/brown ones have been found on site. Even more interesting are the later finds: dark blue, thin (*c.* 1cm) tiles, cut into squares while still hot, and decorated on both sides with curved colourless stripes. Partly preserved circular tiles decorated with opaque red stripes were also found (**Pl. 15**).[21] Nothing similar exists in the surviving monuments of Thessaloniki, Mount Athos, and to the best of my knowledge, elsewhere. With regard to vessel glass from the site, stemmed beakers with solid stems and attached bases are recognizable.[22]

Jewellery

Glass bracelets have been found in the Middle Byzantine layers in Thessaloniki. Although they are not found in large quantities, all the known cross-sections of seamed bracelets, circular, semicircular, band-like and plano-convex ones are known (**Pls 16–17**). The vast majority appear to be black but are in fact made of dark green, dark blue or dark purple glass. Sometimes they are twisted and/or decorated with fine threads of glass of a different, striking colour.[23] Painted examples are very few, unlike the finds from the city's hinterland. Glass rings and glass gems for jewellery and

Plate 16 Silver-stained glass bracelet, 10th century. Museum of Byzantine Culture, Thessaloniki

Plate 17 Glass bracelets, 10th–12th century. Museum of Byzantine Culture, Thessaloniki

Plate 18 Copper-alloy earrings with glass beads, 10th–12th century. Museum of Byzantine Culture, Thessaloniki

Plate 19 Gold bracelets with cloisonné enamel, 9th–10th century. Museum of Byzantine Culture, Thessaloniki

other precious objects are not present among the finds. Beads, at least plain, globular, monochrome ones were constantly in use, either in strands as necklaces, or independently as an additional embellishment of metal jewellery such as earrings (**Pl. 18**). Enamel is occasionally present in the form of cloisonné. In the extant examples opaque white, red, turquoise and blue glass was used (**Pl. 19**).[24]

Window glass

Changes in architectural forms led to the alteration of windows which became far smaller and fewer than in the Early Christian period. These windows were covered with marble or stucco frames in which small pieces of coloured glass were inserted.[25] No historical building in Thessaloniki preserves its original glazing and no finds from the excavations could be connected with the buildings of this period.

Wall mosaics

St Sophia[26]

This 8th-century cross-domed church preserves mosaics from three distinct periods. The barrel vault over the sanctuary is decorated with mosaics with the founders' inscriptions above the cornice. These are written on a narrow gold band dating the mosaic to the AD 790s. Above these is a grid of squares filled with plain leaves and silver-gemmed crosses and finally on the keystone of the barrel-vault, is a multi-coloured glory in the form of a large gold cross outlined in red with rays of light streaming from it.

On the narrow front of the arch between the sanctuary barrel vault and the semi-dome of the apse there is an inscription. Originally a large cross was depicted in the apse; faint traces of the ends of its arms are discernible at the level of the Virgin Mary's shoulders and above her halo. The cross was replaced by a representation of the Virgin Mary enthroned with Christ. It is not known exactly when this was done, but no doubt sometime after the end of the Iconoclastic period (AD 843). In the 11th or 12th century the representation of the Virgin Mary was destroyed from the waist upwards, and the ruined part was replaced.

The dome is decorated with a scene of the Ascension. Along the bottom of the representation runs a decorative band containing two inscriptions. It is generally accepted that the mosaics were executed around AD 885. In the centre of the dome, within a glory supported by two hovering angels, Christ is portrayed seated upon a rainbow. The Virgin Mary orans is depicted in the lower zone flanked by palm trees and two angels who address the apostles. The scene takes place on the Mount of Olives, indicated by the olive trees surrounding the apostles and the rocky ground upon which they stand (**Pl. 20**).

In all three groups of mosaics, dark blue, blue, turquoise, yellow, green, olive green, red, orange, gold and silver glass tesserae were used along with white, grey, black, pinkish red and beige stone tesserae.

Late Byzantine period

Glass working

No archaeological remains of Palaeologan glass workshops have been unearthed in Thessaloniki. However, the size of the city, the volume of goods transported from its harbour, and the large number of people with industrial and

Plate 20 Detail of apostle, Church of St Sophia, Thessaloniki, 9th century

Plate 21 Glass flasks, 14th century. Museum of Byzantine Culture, Thessaloniki

Plate 22 Glass vials, 13th–15th century. Museum of Byzantine Culture, Thessaloniki

commercial concerns who lived there render quite unbelievable the hypothesis that no glass workshops, either for vessels or for flat glass, were active in the city. The fact is that among the movable finds from the excavations conducted in Thessaloniki, many bottles have been found. They are quite diverse and can mainly be ascribed to major glass-working centres such as Venice or Syria (**Pl. 21**).[27] There are some though that could be considered as local products since they cannot be connected with any other major glass centre's traditional style. Several examples are found including small, slightly clumsy, receptacles made of bluish glass and which are probably the ones known from 15th-century sources as perfume holders or containers of St Demetrios' myrrh (**Pl. 22**).[28]

Jewellery

Glass gems and beads were still used by jewellers and were possibly manufactured in the city, while glass bangles gradually disappear after the middle of the 13th century. Small twisted bangles with a circular cross-section prevail among the later examples. According to the few extant examples, pulverized glass, mainly blue, red and white, continued to be used throughout the Late Byzantine period for the enamelling of jewellery, for instance on earrings (**Pl. 23**). Pulverized glass was also used for the embellishment of the metal revetments of the wooden icons that were produced in Palaeologan Thessaloniki.

Window glass

No window glass that can be securely attributed to this period has been preserved. According to the surviving marble and stucco frames of churches dated to this period, small pieces of coloured (?) glass must have been used to fill the openings, while crown glass could have also been used in some cases for the central parts of the frames.[29]

Mosaics

Wall mosaics

Aghioi Apostoloi

The Church of the Holy Apostles, a cross-in-square katholikon of a monastery built between 1312 and 1315, is the single standing Palaeologan building decorated with mosaics.[30] The upper part of its central area is decorated with mosaics which have only partly survived as the gold tesserae used for the backgrounds were removed probably when the church was plastered. The mosaics, executed during the patriarchate of Niphon (1312–15) who was the donor of the church, are the last Byzantine mosaics surviving in Thessaloniki.

They are arranged according to the iconographic programme established in that period and make use of all the available surfaces. At the top of the dome is a bust of the Pantocrator, with ten prophets arranged on the drum of the dome, and the four Evangelists in the pendentives. The rest of the mosaics depict the Twelve Great Feasts, only nine of which survive (**Pl. 24**). The remaining narrow spaces were filled in with holy figures. All the representations are framed with bands of skillfully executed vegetal and geometrical

Plate 23 Copper-alloy earring or temple pendant with enamelling, 13th–15th century. Museum of Byzantine Culture, Thessaloniki

Plate 24 Detail showing the Entry into Jerusalem, Church of Aghioi Apostoloi, Thessaloniki, 1312–15

motifs. Blue, turquoise, yellow, green, red, pinkish red, gold and silver glass tesserae were used along with white and grey stone ones.

Anonymous church on Armatolon Street

The only other extant example of Palaeologan mosaics in Thessaloniki containing glass tesserae come from the area of an anonymous Late Byzantine church. They were found detached from the walls in the rubble and it has been suspected that they were brought onto the site from another nearby ecclesiastical building.[31]

Mosaic icons

Finally, two mosaic icons, which are partly made of glass tesserae and are stylistically connected to the art of Thessaloniki, also demonstrate another way in which glass was employed in the city: the icon of St John the Evangelist at the Great Lavra is connected with the 14th-century painting of Thessaloniki,[32] and the icon of St Demetrios with a *koutrouvion* on it, which has a silver revetment of a Thessalonian type and is considered to be from Thessaloniki, a work possibly meant for wealthy pilgrims to the shrine of the saint.[33]

Conclusion

During the Early Christian period glass was widely used in the production of vessels, tableware, lamps and unguentaria, as well as in the production and embellishment of jewellery. Huge amounts of glass were applied in the decoration of the city's churches and secular buildings throughout this period, while a considerable amount of glass was used for glazing both public and private buildings. The most recent finds ascribed to local workshops are exclusively simple utilitarian vessels, plain or simply inscribed, free- and mould-blown ones.

During the Middle Byzantine period the number of glass vessels found in the city diminished, although a glass workshop producing vessels has been unearthed. In addition, glass continued to be used in the production and the embellishment of jewellery. Furthermore, requirements for window glass due to changes in architectural styles were considerably reduced. Lastly, the use of glass in the production of wall mosaic tesserae was considerable throughout this period; the local production of tesserae and *opus sectile* tiles, at least during the late Middle Byzantine period, has been archaeologically detected.

Finally, no Late Byzantine glass-working remains have been uncovered, although the number of vessels used appears to increase remarkably in comparison to the earlier periods. The need for window glass continued to diminish, while wall mosaics, although present in the city in at least two 14th-century churches, represent a real rarity that was to be forgotten in the city until the second half of the 20th century.

Notes

1 K. Armenopoulos, *Πρόχειρον Νόμων ή εξάβιβλος, επιμ. Κωνσταντίνος Πιτσάκης*, Athens, 1971, Π.Δ'.19, 117–18. Legislation that was in use throughout the Byzantine period and preserved in the 14th-century work of Armenopoulos specifies that glassworkers should not work within cities. In some cases, despite the law, if there was a need for installation within the city walls, then their workshops had to be erected in uninhabited parts of the city because they were a constant cause of disturbance to the inhabitants and a high fire risk.

2 A. Antonaras, *Ρωμαϊκή και παλαιοχριστιανική Υαλουργία. Αγγεία από τη Θεσσαλονίκη και την περιοχή της*, Athens, 2009, 61–75; A. Antonaras, 'Υαλοποιία και υαλουργία στο ρωμαϊκό και παλαιοχριστιανικό κόσμο. Υαλουργική δραστηριότητα στη Θεσσαλονίκη', *Αρχαιολογικόν Δελτίον Μελέτες* 57, 2002 (2010), 237–60. Another Early Byzantine glass workshop has been excavated recently in the centre of the city at 45 Vasileos Irakleiou Street; this will be published by the author.

3 A. Antonaras, 'Early Christian and Byzantine glass vessels: forms and uses', in F. Daim and J. Drauschke (eds), *Byzanz - das Römerreich im Mittelalter, Teil. 1 Welt der Ideen, Welt der Dinge*, Darmstadt, 2010, 383–430.

4 Antonaras 2009 (n. 2), 75–84; A. Antonaras, 'Production and distribution of glass objects in Late Antique Thessaloniki (3rd–7th c. A.D.)', in *Round Table: L'artisanat grec: Approches méthodologiques et perspectives, Ecole française d'Athènes*, 4–7 October 2007, in press; A. Antonaras, 'Glass working activities in Late Roman-Early Christian Thessaloniki. Local workshops and vessels', in J. Drauschke and D. Keller (eds), *Glass in Byzantium. Production, Usage, Analyses* (International Workshop organized by the Byzantine Archaeology Mainz, 17 and 18 January 2008 Römisch-Germanisches Zentralmuseum), Mainz, 2010, 93–105; A. Antonaras, 'Glass doves and globes from Thessaloniki. North Italian imports or local products?', *Quaderni Friulani di Archeologia 19, Atti dell convegno INTORNO ALL'ADRIATICO. Trieste – Piran 30–1 maggio* (2009), 27–33.

5 For jewellery in the Late Antique city see: S. Pelekanidis, 'The gold Byzantine jewellery of Thessaloniki', *Δελτίον Χριστιανικής Αρχαιολογικής Εταιρείας περ. Δ- τ. 'Α'* (1959), 55–71; N.D. Makropoulou, 'Κοσμήματα από τον 3ο έως τον 6ο αι. μ.Χ. από ανασκαφές της Θεσσαλονίκης. Συμβολή στη μελέτη της παλαιοχριστιανικής αργυροχρυσοχοϊας', *Θεσσαλονικέων Πόλις* 3 (1997), 56–69; N. D. Makropoulou, 'Παλαιοχριστιανικά κοσμήματα από τη Θεσσαλονίκη', in *230 Συμπόσιο Βυζαντινής και Μεταβυζαντινής Αρχαιολογίας και Τέχνης της Χ.Α.Ε., Πρόγραμμα περιλήψεων εισηγήσεων και ανακοινώσεων*, Athens, 2003, 61–2. For a thorough overview of Early Christian glass jewellery found in Thessaloniki see: A. Antonaras, 'Glassware in Late Antique Thessalonikē', in L. Nasrallah, Ch. Bakirtzis and S.J. Friesen (eds), *From Roman to Early Christian Thessalonikē. Studies in Religion and Archaeology*. A Conference on Religion and Archaeology, Harvard Divinity School, May 10–14, 2007, Cambridge (MA), 2010, 301–34.

6 D. Nalpantis, *Ανασκαφή στο οικόπεδο του Μουσείου Βυζαντινού Πολιτισμού στη Θεσσαλονίκη*, Athens, 2003, 35, 133, drawing 10, tab 45, jet bracelet from a grave of the first half of the 4th century; Antonaras (n. 5).

7 A. Antonaras, in A. Tsakalos (ed.), *Enamels. Colour in the Course of Time* (exh. cat., Byzantine and Christian Museum 21 December 2007–17 February 2008), Athens, 2008, 49, 51–2; Antonaras (n. 5).

8 S. Pelekanidis, 'Η εκτός των τειχών παλαιοχριστιανική βασιλική των Φιλίππων', *Αρχαιολογικόν Έργον* 1955 (1961), 114–79, reprinted in S. Pelekanidis, *Μελέτες παλαιοχριστιανικής και βυζαντινής αρχαιολογίας*, Thessaloniki, 1977, 333–95; E. Kourkoutidou-Nikolaidou, 'Vitraux paléochrétiens à Philippes', *Corsi di cultura sull'arte ravennate e bizantina XXXI* (1984), 277–96; A. Antonaras, 'Early Christian glass finds from the Museum Basilica, Philippi', *Journal of Glass Studies* 49 (2007), 47–56, fig. 2.

9 A. Romiopoulou, 'Νοσοκομείο ΑΧΕΠΑ', *Αρχαιολογικόν Δελτίον* 31 (B2) (1976), 241–2, pl. 194a, where considerable quantities of window glass were found in the debris of a 3rd-century bath house, possibly part of a Roman villa. Also, similar unpublished material has been unearthed in the Roman villa under Galerius' palace, dated to the second half of the 3rd century. I express my thanks to the excavator of the site, Mrs M. Karaberi, for sharing this information with me.

10 P. Asimakopoulou-Atzaka, 'Τα παλαιοχριστιανικά ψηφιδωτά δάπεδα του ανατολικού Ιλλυρικού', *Actes du Xe Congrès international d'archéologie chrétienne. Thessalonique 28–9/4–10 1980, vol. I, Thessalonique/Città del Vaticano*, Thessaloniki, 1984, 364–444, esp. 407–8; eadem, *Σύνταγμα των παλαιοχριστιανικών ψηφιδωτών δαπέδων της Ελλάδος. III. Μακεδονία Θράκη. 1. Τα ψηφιδωτά δάπεδα της Θεσσαλονίκης*, Thessaloniki, 1998, 112–13.

11 A rich *villa urbana* at 7 Lapithon Street dated to the second half of the 5th century by Asimakopoulou-Atzaka 1998 (n. 10), 258–9. Glass tesserae are used only in the octagonal frames with zoomorphic depictions; a monumental corridor in the eastern necropolis in the cemetery of Evangelistria is dated to the first half of the 6th century (ibid., 154, 263–4, pl. 187, XLVII, XLVIII); also a church at the intersection of Ag. Demetriou and Langada Street where some green and blue glass tesserae were used has been dated to the last quarter of the 5th to the first half of the 6th century (ibid., 262); a wealthy household at 90 Kassandrou Street where yellow, green, orange, and red glass tesserae were used in the central room of the western part of the house (ibid., 234–6, dated probably to the end of the 4th century); a large building at 24 Palaion Patron Germanou Street had greenish-light blue tesserae from its earliest phase of construction which predates the 4th century (ibid., 341).

12 E.g. a circular building in the upper part of the city at 6–12 Aiolou Street, 9th Ephoreia: see, *9η Εφορεία Βυζαντινών Αρχαιοτήτων Θεσσαλονίκης, Σωστικές Ανασκαφές 2003, Λουτρά Παράδεισος (Μπέη Χαμάμ)*, Thessaloniki, 2004, 8.

13 H. Torp, *Mosaikkene i St. Georgs rotunden i Thessaloniki. Et hovedver I tidlig-Byzantisk Kunst*, Oslo, 1983; E. Kleinbauer, 'The iconography and the date of the mosaics of the Rotunda of Hagios Georgios, Thessaloniki', *Viator* 3 (1972), 27–107; M. Sotiriou, 'Προβλήματα της εικονογραφίας του τρούλλου του ναού του Αγίου Γεωργίου Θεσσαλονίκης', *Δελτίον Χριστιανικής Αρχαιολογικής Εταιρείας, περ. Δ- τ. ΣΤ'*, (1970–2), 191–204; G. Gounaris, 'Οι τοιχογραφίες του τάφου αρ. 18 της Θεολογικής σχολής του Α.Π.Θ', *Εγνατία* 2 (1990), 201–26; E. Kourkoutidou-Nikolaidou and A. Tourta, *Περίπατοι στη βυζαντινή Θεσσαλονίκη*, Athens, 1997, 48–69.

14 Ch. Bakirtzis and P. Mastora, 'Are the mosaics in the Rotunda in Thessaloniki linked to its conversion to a Christian Church?', in *9. Medunarodni naučni skup NIŠ I VIZANTIJA (3-5.6.) – U susret obeležavanju godišnjice Milanskog edikta/9th International Symposium "Nis i Vizantija" (3–5 June 2010): Towards the Celebration of the Edict of Milan Anniversary*, in print.

15 An average tessera weighs *c.* 1–1.5g, covering 0.7–0.9 sq.cm. If we add the seam around each one of them, we see that they cover *c.* 1 sq.cm with *c.* 1.2g of glass. Thus for every square metre of mosaic approximately 12 kilos of glass were needed. The Rotunda's wall mosaics would originally have covered *c.* 1414 sq. meters. If we multiply this by 12, we arrive at around 17 tons of tesserae for the Rotunda's decoration, of which glass should be roughly 13 tons.

16 A. Xyngopoulos, 'Περί την Αχειροποίητον Θεσσαλονίκης', *Μακεδονικά* 2 (1947–52), 472–87; Ch. Bakirtzis, 'Sur le donateur et la date des mosaïques d'Acheiropoietos à Thessalonique', *Atti del IX congresso internationale di archeologia cristiana, Roma 1975*, II, Rome, 1978, 37–44; E. Kourkoutidou-Nikolaidou, *Αχειροποίητος, ο μεγάλος ναός της Θεοτόκου*, Thessaloniki, 1989; Kourkoutidou-Nikolaidou and Tourta (n. 13), 185–95.

17 A. Xyngopoulos, 'Το καθολικόν της Μονής Λατόμου εν Θεσσαλονίκη και το εν αυτό ψηφιδωτόν', *Αρχαιολογικόν Δελτίον* 12 (1929), 142–80; F. Gerke, 'Il mosaico absidale di Hosios David in Salonicco', *Corsi di Cultura sull'arte ravennate e bizantina* 11 (1964), 179–99; N. Gioles, 'Εικονογραφικές παρατηρήσεις στο μωσαϊκό της Μονής Λατόμου στη Θεσσαλονίκη', *Παρουσία* 2 (1984), 83–94; J.-M. Spieser, 'Remarques complémentaires sur la mosaïque de Osios David', *Διεθνές Συμπόσιο: Βυζαντινή Μακεδονία 324–1430 μ.Χ.*, Thessaloniki, 1995, 295–306; Kourkoutidou-Nikolaidou and Tourta (n. 13), 91–9.

18 G.A. Sotiriou and M.G. Sotiriou, *Η Βασιλική του Αγίου Δημητρίου Θεσσαλονίκης (Εν Αθήναις Αρχαιολογι κή Εταιρεία*, 34), 2 vols, Athens, 1952, passim; R.S. Cormack, 'The mosaic decoration of S. Demetrios, Thessaloniki. A re-examination in the light of the drawings of W.S. George', *Annual of the British School at Athens* 64 (1969), 16–52; A. Xyngopoulos, *Τα ψηφιδωτά του ναού του Αγίου Δημητρίου Θεσσαλονίκης*, Thessaloniki, 1969; Th. Papazotos, 'Το ψηφιδωτό των κτητόρων του Αγίου Δημητρίου Θεσσαλονίκης', *Αφιέρωμα στη μνήμη Στυλιανού Πελεκανίδη*, Thessaloniki, 1983, 365–75; X. Bakirtzis, *Η βασιλική του Αγίου Δημητρίου*, Thessaloniki, 1986.

19 Armenopoulos (n. 1), 117–18.

20 I.O. Kanonidis, 'Ανασκαφή εργαστηρίου υαλουργίας στην Πλατεία Διοικητηρίου της Θεσσαλονίκης', in P. Themelis (ed.), *Το γυαλί από την αρχαιότητα έως σήμερα, Β' Συνέδριο Μαργαριτών Μυλοποτάμου Ρεθύμνης Κρήτης, Μαργαρίτες Μυλοποτάμου, 26–28 Σεπτεμβρίου 1997*, Athens, 2002, 143–53.

21 D. Papanikola-Bakirtzi (ed.), *Everyday Life in Byzantium, Byzantine Hours. Works and Days in Byzantium* (exh. cat., Thessaloniki, White Tower, October 2001–January 2002), Athens, 2002, 119–20, no. 115a, dated generally in the Middle Byzantine period. For the excavation see: I.O. Kanonides, 'Οδός Αγάπης 3', *Αρχαιολογικόν Δελτίον* 51 (1996), 490–3.

22 *Cf.* G. Davidson, *Corinth: Results of Excavations conducted by the American School of Classical Studies at Athens, Volume XII, The Minor Objects*, Princeton, N.J., 1952, 110, nos 712–14; Antonaras (n. 3), fig. 40, vessel, lower row, left end.

23 A. Antonaras, 'Γυάλινα μεσοβυζαντινά βραχιόλια. Συμβολή σε θέματα διάδοσης, παραγωγής, τυπολογίας και χρήσης', *Δελτίον Χριστιανικής Αρχαιολογικής Εταιρείας*, π. Δ', τ. ΚΖ' (2006), 423–34.

24 Pelekanidis (n. 8), 333–95. For colour representations see: A. Antonaras in R. Cormack and M. Vassilaki (eds), *Byzantium 330–1453* (exh. cat., Royal Academy of Arts, London, 25 October 2008–22 March 2009), London, 2008, 182.

25 On the Middle Byzantine churches of the city see: S. Ćurčić, *Architecture in the Balkans from Diocletian to Süleyman the Magnificent*, New Haven and London, 2010, 277–80, 369–73.

26 S. Pelekanidis, 'I mosaici di Santa Sophia di Salonicco', *Corsi di cultura sull'arte ravennate e bizantina* 11 (1964), 337–49; S. Pelekanidis, 'Bemerkungen zu den Altarmosaiken der Hagia Sophia zu Thessaloniki und die Frage der Datierung der Platytera', *Βυζαντινά* 5 (1973), 29–40; R. Cormack, 'The apse mosaics of S. Sophia at Thessaloniki', *Δελτίον Χριστιανικής Αρχαιολογικής Εταιρείας περ. Δ' – τ. 1* (1980–1), 111–35; Ch. Bakirtzis, 'Νεώτερες παρατηρήσεις στην κτιτορική επιγραφή του τρούλλου της Αγίας Σοφίας Θεσσαλονίκης', *Βυζαντινά* 11 (1978), 167–80; X. Mavropoulou-Tsioumi, 'Η ζωγραφική στη Θεσσαλονίκη τον 9ο αι', Πρακτικά Συνεδρίου προς τιμήν και μνήμην των Αγίων αυταδέλφων Κυρίλλου και Μεθοδίου των Θεσσαλονικέων, φωτιστών των Σλάβων', *Θεσσαλονίκη* 1 (1986), 393–410.

27 On a special form of lentoid flask see: A.C. Antonaras, 'Venetian glass pilgrim vessels found in Thessaloniki', in *15th International Congress of the International Association for the History of Glass, New York*, Corning, N.Y., 2001, 199–202. For a general overview of glass vessels see, Antonaras (n. 3), 408–22.

28 O. Papazotos, 'Μερικές πληροφορίες για τη Θεσσαλονίκη από τον J. Van Ghistele (1483)', *Ιστορικογεωγραφικά* 5 (1995), 51–6.

29 An unpublished part of a mortar window closure from the Church of Saint Panteleemon that preserved small fragments of purple glass is kept in the Museum of Byzantine Culture. Also, similar finds from Agios Demetrios of an unknown date are exhibited in the crypt of the church. Generally, on the Late Byzantine churches of the city see, Ćurčić (n. 25), 545–59.

30 See, N. Nikonanos, *The Church of the Holy Apostles in Thessaloniki*, Thessaloniki, 1986; *ODB*, 940–1.

31 A find from a rescue excavation esp.14–16 Armatolon Street: see *9η Εφορεία Βυζαντινών Αρχαιοτήτων Θεσσαλονίκης, Σωστικές Ανασκαφές 2004, Λουτρά Παράδεισος (Μπέη Χαμάμ)*, Thessaloniki, 2005, 5.

32 K. Loverdou-Tsigarida, 'Thessalonique, centre de production d'objets d'arts au XIV siècle', *Dumbarton Oaks Papers* 57 (2003), 241–54, esp. 251, fig. 17; M. Chatzidakis, 'Une icône en mosaïque de Lavra', *Jahrbuch der Österreichischen Byzantinistik* 21 (1972), 71–83.

33 Loverdou-Tsigarida (n. 32), 247–8, fig. 7. It is dated to the second half of the 14th century and belonged to Cardinal Bessarion.

Chapter 18
'To Beautify Small Things'
Minutiae and Majesty in the Mosaics of Parentium

Ann Terry[1]

The wall mosaics from the Roman town of Parentium, now Poreč, on the Adriatic coastline of Croatia, command pride of place in a cathedral complex built in the middle of the 6th century by Bishop Eufrasius. Henry Maguire and I studied these mosaics for a decade, both from scaffolding in several campaigns and through documents detailing their 19th-century restoration.[2]

Much has been written in recent years about the role of the viewer in the art of this period.[3] The approach of this paper, partial to the *terra firma* of tesserae and setting bed, is more closely aligned with the opposite stance, that of the 6th-century artisans. Both points of view, those of the viewer and the artisan, were certainly well recognized in antiquity. Avitus, Bishop of Vienne, in a letter of the early 6th century, imagined the impending dedication of a new church, filled, as is the one at Parentium, with reflective splendour. He anticipated the appreciation of those in attendance: 'In their praise they could elaborate on the quality of the marbles from which only jealousy of their size removes the appellation of jewels. Daylight, somehow gathered and industriously closed in is enlivened by the glow of splendid metals.'[4] He was hardly alone in his recognition of the labour and skill required to produce the luminous special effects of the time. But what, precisely, was done so industriously?

This paper begins with the big picture, a look at what one might call, for lack of a better term, the architectonics of the mosaics: that is the structural arrangement of the subjects, their relationship to one another and to the architecture itself. It will then turn to the more archaeological minutiae, which, when studied at close range from the physical stance of the original mosaicists, are revealing of their techniques and methods. Presenting a selection of such examples is the primary purpose of this paper. Ironically, and delightfully, the concerns of the artisans with materials and their manipulation point towards the nature of the viewer's visual experience of the mosaics. With that in mind, this paper highlights examples that might be of interest to questions of aesthetics, especially the question of luminosity, with which the paper will end. Another intent here is to side step the kind of visual analysis that characterizes Byzantine art in terms of its deviation from or adherence to classical norms. It is a tall order to characterize that which gave visual delight and resonance in the mosaics using terminology antithetical to its nature. I am hoping that the view of 'small things' might help find new words.

Let us start with the mosaics (**Pl. 1**). Christ and the Apostles occupy the upper wall of the triumphal arch. Virgin saints in roundels are featured on the intrados of the arch. In the semi-dome, against a cloud-filled golden sky, the hand of God extends a wreath above the Enthroned Virgin and Child, who are flanked by archangels presenting heavenly and earthly dignitaries. On the left, Maurus, the patron saint and early bishop of Parentium is followed by Bishop Eufrasius who offers a model of the church he has just had built, as detailed in the mosaic inscription below. By Eufrasius' side stands Claudius the Archdeacon and his son, also named Eufrasius. On the right, three unnamed saints approach the Virgin. At window level, in the drum of the apse, two narrative scenes, and three standing figures are crowned with a wide band of intricately wrought shells.

Plate 1 Main apse, vault and triumphal arch, Basilica of Eufrasius, Poreč

Plate 2 Main apse, general view, Basilica of Eufrasius, Poreč

Flanked by scenes of the Annunciation and Visitation, Zacharias, an angel and John the Baptist stand as sentinels between the four large windows. The fragmentary side apses each depict Christ holding crowns over the saints on the north and bishops on the south. Next to nothing remains of the mosaics that once decorated the external upper façades.

Typically figures or groups of figures are set into architectonic units outlined with distinctive borders, here with jewelled bands of red and gold. Similar principles have deep roots in Roman painting, the most immediate predecessor being those in catacombs, where figures, objects and narratives are typically outlined in red and green. Such borders are said to divide units, but they knit them together as well. The principle of axiality was a powerful tool in the purposeful constellation of imagery in the mosaics at Parentium. While acknowledging multiple levels of meanings, the focus here is on a Christological interweave constructed with horizontal and vertical axes (**Pl. 2**). An unswerving vertical proclaims Christ's divinity: Christ on the triumphal arch; the lamb on the intrados of the arch (replacing a portrait of Christ known from the 18th century), the hand of God above the Virgin and Child, the Christ Child, the cross on the Virgin's stole, the cross held by the standing angel, and the cross of Golgotha in *opus sectile* above the *cathedra*. Significant details such as the abbreviation of Christ's name in the mosaic inscription underscore this intention. If Christ's divinity established his vertical rule, his humanity held pride of place at the very heart of the composition in the commanding figure of the Virgin, who connected the vertical with the horizontal axes. Humanity occupies the horizontal axes, ours and Christ's: the apostles on the upper wall, the ecclesiastical luminaries and saints approaching the Virgin, and beneath them, and closest to earth and most critically incarnational, the narratives of the Annunciation and Visitation, and the testimonial presence of Zacharias, an angel and John the Baptist. The intimate and emotive narratives of the Annunciation and Visitation, the latter with the very visibly swollen bellies of the two pregnant kinswomen give palpability to theological mystery. The virgin saints in medallions, occupying the intrados of the triumphal arch, bind the horizontal and vertical axes together.

The relationship between axiality in the mosaics and the architecture itself brings both further to life. The dominant architectural axis, taking up where the vertical axis of the mosaic ended, longitudinally linked the basilica, atrium and baptistery (**Pl. 3**). The arches in the east and west arcade of the atrium, higher than those in the north and south

Plate 3 Plan of the cathedral complex, Basilica of Eufrasius, Poreč

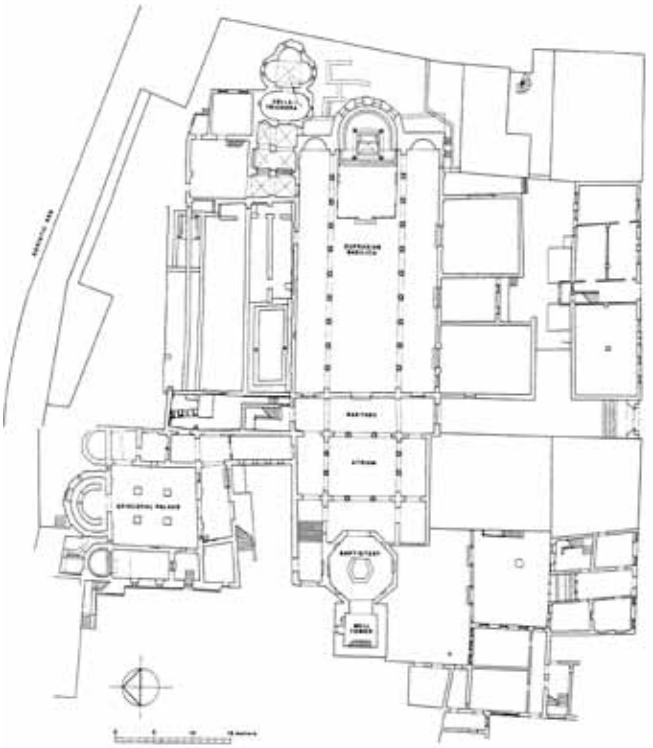


Plate 4 Central portion of shell 2, main apse, north wall, Basilica of Eufrasius, Poreč

Plate 5 Jewelled and ribboned florette borders on lower right side, main apse, vault, Basilica of Eufrasius, Poreč

arcades, draw attention to that primacy. Originally, the three aisles of the basilica flowed seamlessly into the atrium and then around an ambulatory that once surrounded the baptistery, but which has since disappeared. The antiphonal nature of the hexagonal main apse and the hexagonal font in the baptistery is especially striking, tying the cleansing waters of baptism with the triumph of Christ's resurrection.

Additionally, the vertical axis of the mosaics was anchored architecturally at the focal point of the longitudinal axis of the basilica. The episcopal presence upon the *cathedra* was crowned, as it were, by the triumphal cross of Golgotha. The placement of the *cathedra* may well have dictated the positioning of the apse itself, the only part of the basilica that Eufrasius built entirely anew, and the placement of which actually made his basilica smaller than the previous one. A Late Antique inscription identifying Maurus as a bishop and confessor, and associating him with the early church building was placed at the foot of the *cathedra* in the 13th century, but there is reason to believe that it was originally part of a shrine or *memoria* on the outside of the earlier basilica.[5] The *cathedra* of the 6th-century apse was set directly above that *memoria*. A second longitudinal axis joined a twin basilica that once stood to the north, the site of Maurus' early church, to the bishop's palace, a structure that was copied as the house of the Virgin of the Annunciation. Mosaics and architecture thus collaborated, constructing a sacred order encompassing heaven and earth, at once an epic of redemption and a proclamation of episcopal authority.

Lofty as these architectural and iconographical heights are, to approach the decidedly visual impact of the mosaics, to enact the drama it is necessary to deal with the very substance of their materials. Visual power and its ability to stir the senses, originate, I suggest, in the properties and manipulation of materials. Mosaicists used an array of materials, many colours of glass, various marbles, mother of pearl, limestone, and brick in red and yellow and a slate-like stone. Glass was the material of choice, with greens and blues predominating, followed by purples and yellows. It would be impossible to overemphasize the enormous variation in hues, true both of individual tesserae and in areas that appear as a single colour (**Pl. 4**). Blues, greens and yellows may appear in one cube; the red cubes ubiquitous in the jewel bands are shot through with black and sometimes with orange. The expanse of cobalt blue of the background to the Annunciation, for example, when viewed at close range, becomes a random mix of different casts of blues.

The artisans at the Eufrasian basilica understood a hierarchy of materials, the more expensive of which were less abundant. Most precious was the face of Eufrasius, made entirely with a special palette of opalescent glass cubes, tesserae unique to this mosaic both in their range of pastel tints and miniature size. In the faces of the Virgin and Child, the milky white and opaque pale blues and lavenders, though not unique, were rare and highly prized.[6] Orange glass was reserved for highlights, and a very dark red, typically cut very narrowly, outlined costumes and other objects.[7]

When choice materials ran short, the mosaicists applied alternatives, particularly red brick instead of red glass, slate grey stone for blue glass, yellow brick for yellow glass or gold, and local white limestone for marble. This is seen in less prominent areas, like the border of ribboned florettes tucked away behind the intrados (**Pl. 5**). Here one sees a full range of substitutes, yellow brick for yellow glass, slate for blue glass and red brick for red glass. And in the side apses, particularly the south apse, which was completed last, severe shortages forced draconian measures.[8] Here the jewelled border is brick and the rinceaux have precious little glass. At the same time, it is important to note that some of these less expensive materials also served aesthetic purposes: for example, the use of yellow brick combined with yellow glass in the costume of Elizabeth, or to model lime green.[9]

Plate 6 Shells 1–3, main apse, north wall, Basilica of Eufrasius, Poreč

Plate 7 Shell 2, main apse, north wall, Basilica of Eufrasius, Poreč

Mosaicists, as Irina Andreescu-Treadgold discovered in her work in Ravenna, worked in teams, back to back, dividing a given area in half along a vertical axis.[10] At Poreč, variations in materials and techniques indicate a similar practice, but the division was neither strict nor consistent. In the south apse, the lower part was split evenly from the centre, but the wall above was not divided at all. Other areas, such as the shells in the semi-dome and roundels on the triumphal apse, were split unevenly. The nine shells that circle the apse, lacking iconographical distinctions, offer a good example. The four on the left (north) were done by one artisan or team; the five on the right by another, as seen in a number of consistently applied distinctions, only a couple of which can be cited here.[11] In the left shells (**Pl. 6**), the shadow beneath the upper valve uses two rows of coloured glass best seen in **Plate 7**; the right shells use different materials (lighter purple glass and slate stone, best seen in **Plate 8**) and a different technique (short hatched lines). The highlighting of the north scallops, on the left, uses continuous rows of red, orange, pink and white, while on the right shells, these colours line one side of the curve. The gold cubes in the shells on the left are tilted in their beds so as to catch the light, but not those on the right.

Mosaicists had many techniques and tricks for settings. For example, faces, as small areas with many organic shapes, challenged the medium. Formulaic setting patterns, though not always rigidly applied, made this job easier. The setting of cheeks is revealing, both of type and quality. For example, cheeks forming symmetrical, spherical triangles suited bearded, frontal faces, such as those of Eufrasius and Claudius (**Pl. 9**). Often three-quarter faces have asymmetrical cheeks, one gently curved and the other with an accentuated curve, as seen in the faces of Maurus and a saint.[12]

Ways of making transitions between colours speaks to a visual intelligence of materials. The geometric and fragmentary nature of the mosaic medium has been seen as a negative, impeding the modelling of form. This was less the case with the mosaicists, who played to their tesserae and setting colours not by 'blending' so much as by placing them in deliberate and sometimes formulaic opposition to one another. The shoulder of Agnes, depicted on the intrados, illustrates what might be called 'dots and dashes' to move from white to blue, in this case from turquoise blue to light green and then to white (**Pl. 10**). A row of white cubes, outlining her gown, is followed by an alternation of white and green cubes in a pattern of dots, then a row of all green, and then several rows alternating green with blue in a dotted fashion. This is one of a number of such techniques that seem to reflect a taste for point and counterpoint, for placing elements in opposition to another. This same aesthetic, according to Michael Roberts, permeated Late Antique poetry.[13] What he called a 'fellowship of opposition' ruled spacing and framing devices and the separation of small units of composition he found echoed in the composition of figural elements.

Similarly, adding visual interest and/or alleviating plain areas of a single colour, or a potentially monotonous set of rows, are 'stray diagonals', a row or rows of cubes set deliberately at an angle to a prevailing vertical pattern. For

Plate 8 Shell 5, main apse, central pier, Basilica of Eufrasius, Poreč

Plate 9 Head of Claudius, main apse, vault, Basilica of Eufrasius, Poreč

Plate 10 St Agnes, main apse, intrados, Basilica of Eufrasius, Poreč

Plate 11 Lower portion of Claudius, main apse, vault, Basilica of Eufrasius, Poreč

example, in the vestments of Claudius, a diagonal row of grey–green cubes veer off track, cutting across several vertical rows of white. Above his right foot, the uppermost of four horizontal dashes in pale green is set at a diagonal, as is the row beneath it (**Pl. 11**).[14] These passages run counter to the momentum of the surrounding setting pattern, thus absorbing time and energy, so we know that they were intentional and desired.

A 'crow-step' pattern, employed as a simple decorative border in the roundel at the centre of the intrados (**Pl. 12**), was also used in drapery, for example, in the tunic of the archangel at the Eufrasiana, where it is partly obscured by restoration. It is a feature used in the mosaics at Ravenna, at Sant'Apollinare Nuovo, for example. Other tricks targeted specific elements, such as drapery folds. A figure of eight or type of interlace appears on the upper leg of some figures, perhaps suggestive of movement, as with the Archangel Gabriel from the Annunciation scene (**Pl. 13**).[15]

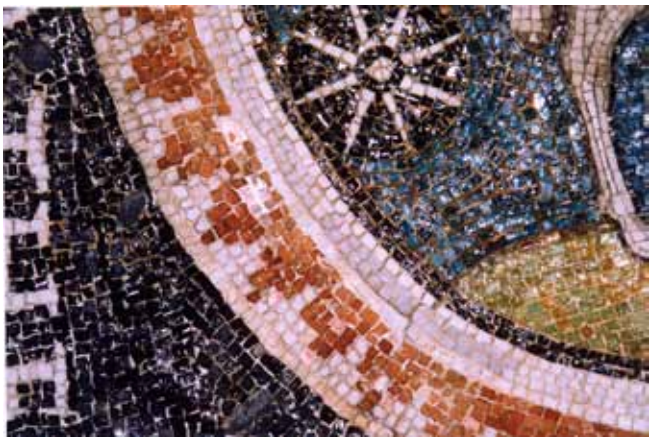


Plate 12 Detail of border, main apse, intrados, Basilica of Eufrasius, Poreč

Some of the preoccupations of the mosaicists come as a surprise. It is widely accepted that mosaicists of this period showed little interest in highly naturalistic representational forms, especially in the human figure. However, they did have an interest in different kinds of, for lack of a better term, realistic detail. The mosaicist responsible for the crown of Maurus lavished his labour on constructing textual relief. Large dark cubes consistently projecting above the surface comprise the outlines of the leaves, while much smaller and more deeply set cubes make up the centres of the leaves (**Pl. 14**).[16] It is worth noting that this elaboration is impossible to see from the ground. Details and textiles drew similar interest. In the curtain of Eufrasius' model of the church, tiny white stones mingle with large cubes of a creamy marble to create a pattern simulating fabric (**Pl. 15**). Detailed attention was preferentially given to cloth and costume throughout the mosaics. For example, this curtain hangs from hooks, reminiscent of the striking bronze finger

Plate 13 Archangel Gabriel, Annunciation scene, main apse, north wall, Basilica of Eufrasius, Poreč

Plate 14 St Maurus, main apse, vault, Basilica of Eufrasius, Poreč

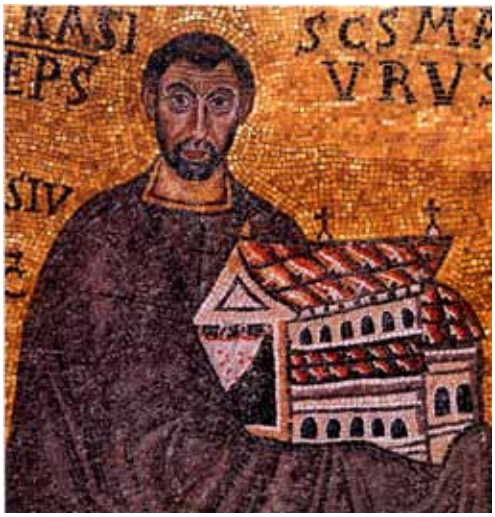


Plate 15 Bishop Eufrasius and church model, main apse, vault, Basilica of Eufrasius, Poreč

Plate 16 Visitation scene, main apse, south wall, Basilica of Eufrasius, Poreč

hooks on the main door nearby, rather than on rods, as in the curtain shown in the Visitation.[17] This taste for realism appears most consistently in the costumes worn by the figures, especially in the minutiae of stitching, embroidery, fringe and details in shoes. These are small details, not all of which were visible from the ground, and easily missed in the search for the modelling of human form.

Finally, to turn to the issue of light and colour, there was a considerable use of what might better be called luminosity. Amongst all the techniques wielded by mosaicists, those that exploited the variously reflective, textured and coloured cubes to intensify light effects merit special consideration. Art historians have tended to approach wall mosaics as they would a two-dimensional painting, separating light and colour. This has obscured other aesthetic values, especially those of luminosity, shine or brightness, which, as Liz James' study of texts has shown, was how the Byzantines understood what we separate into the categories of light and colour.[18]

On a very simple pictorial level, the drive for intensity of hue appears in the colouristic 'glow' around the figures, a kind of radiance. In the Visitation scene, for example, both the Virgin and Elizabeth are enveloped from foot to shoulder in a glow lighter in value than the surrounding hue, turquoise against cobalt blue and lime green against the emerald green ground (**Pl. 16**); the same with Zacharias (**Pl. 17**).[19] It might seem fitting to read the radiance exclusively in iconographical terms as a representation of divine light. But the radiance around the pregnant kinswomen ends abruptly where the reflective glasses meet the brick cubes, a material with no reflectivity. This suggests that it was not just the figure but also the reflective properties of the materials that directed the application of technique. The practice is grounded in the knowledge that the uneven surfaces of the coloured glass tesserae would both highlight and intensify one another, quickening the visual stimuli for the spectator, and imbuing the figures with a dramatic presence suggestive of movement.

In looking at specific materials, gilded tesserae and amber glass were much esteemed for their distinctive reflective and colouristic properties and were used with remarkable agility and sensitivity. Amber glass functioned as a wild card in the mosaicists' palette, being warm, light as well as dark and light-generating in its near transparency. This glass came in a variety of tints including brown, honey, green and rose. Used both as a base for gold and in an ungilded state, amber was mined in ways that demonstrate a keen awareness of its transient effects (**Pls 18–19**).[20] Chameleon-like in nature, amber assumed different roles in different contexts. It well represented objects like the occulus from the Visitation, and was effective, because it was neither too dark nor too light, in outlining faces and other forms. Variable in value, amber made a subtle and suggestive compromise between light and dark, and bridged the gap between the flatter colour of the opaque glass cubes and the more constant shimmer of gold.

If amber claimed the most versatility, gold took the lead in luminosity. The original gold tesserae were brilliant and reflective, but still a far cry from the blinding flat planes produced by the restorer's gold, seen in large swathes in the apse. When the restored halo of the Christ Child is

Plate 17 Zacharias, main apse, north pier, Basilica of Eufrasius, Poreč

Plate 18 Basket, Annunciation scene, main apse, north wall, Basilica of Eufrasius, Poreč

Plate 19 Casket of Zacharias, main apse, north pier, Basilica of Eufrasius, Poreč

compared with the largely original halo of Christ in the south apse, it becomes apparent how one produces a mirror finish, while the other, its tesserae, each individual in topography, angle and depth of setting, created a mutable and pervasive shimmer (**Pls 20–1**).[21] Gold was also used selectively and pointedly in slithers in the hair only of the archangels and Christ Child.

As visually valuable as amber and gold were, it was the interplay of amber, gold, yellow and lime green glass and yellow brick that created the richest and most mercurial light effects. Lime green glass was used to model gold and forestall excessive visual heaviness. Too much gold is too much gold. From certain angles, the gold and lime green are indistinguishable from one another. In the gold band lining Zacharias' robe, two rows of gold are softened and set off by yellow glass and yellow brick. The metallic sheen of Zacharias' box is an ingenious weave of gold, yellow brick, yellow glass and translucent amber cubes (**Pls 17, 19**).[22] By intermingling various golden colours, the mosaicists achieved a rippling, iridescent shimmer on the insides of the scallop shells, where vertical rows fall in cascades of luminescent colour (**Pl. 22**).[23]

The experience of luminosity was both dynamic and disorienting. The tessellated wall itself could work only some of the magic. The rest was, if you'll forgive the expression, off the wall, involving highly variable complexities such as the architectural space, lighting conditions (day, night, candles, oil lamps, windows of alabaster or translucent glass), and, most critically, the movements of the viewer throughout the building. With every movement the viewer took in space, the reflective natures of the gleaming materials became highly mobile and mercurial, charging not just the surface of the mosaic but also the space it encloses.

That these effects cast a dizzying spell is abundantly clear from contemporary accolades. 'The beholder', wrote Procopius, 'is utterly unable to select which particular detail he should admire more than the others.'[24] Sidonius, describing the palace of Dawn, whose walls dazzled with precious metals, gems and pearls, reported that 'the various sights distract your gaze and by the skill of artistry whatever you see takes precedence'.[25]

While we today might look to entertainment for a sensory and transitory high, the artistry of Byzantine mosaics had a different purpose altogether. It brought heaven to earth. Procopius famously wrote of Hagia Sophia that 'the interior is not illuminated from without by the sun, but that the radiance comes into being within it'.[26] Fortunatus, a contemporary of Eufrasius and familiar with mosaics in Ravenna, where he received his literary education, described Notre Dame Cathedral in Paris in similar terms: 'it shone with its own rays even without the sun'.[27] Fortunatus went on to parallel that precious radiance with the incarnation: 'full of radiant light the church imitated Mary; she enclosed light in her womb, it enclosed day'.[28]

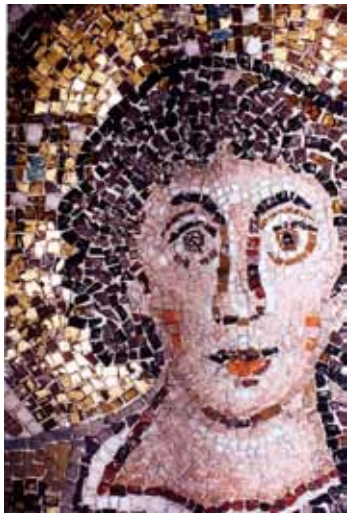


Plate 20 Head of Christ, main apse, vault, Basilica of Eufrasius, Poreč

Plate 21 Head of Christ, south apse, Basilica of Eufrasius, Poreč

Plate 22 Shell 6, main apse, south pier, Basilica of Eufrasius, Poreč

In Parentium, the book Christ holds reads 'Ego sum lux vera' ('I am the true light'). Beneath him the resplendent mosaics created their own ontology making manifest the very presence of the divine. In harnessing multiple qualities of light, the mosaics assumed the power to generate light. Bishop Peter II from Ravenna, from his inscription in the Archbishop's Chapel in Ravenna, made this connection crystal clear:

> Either light was born here, or captured here it reigns free; it is the law, from which source the current glory of heaven excels. The roofs, deprived [of light], have produced gleaming day, and the enclosed radiance gleams forth as if from secluded Olympus. See the marble flourishes with bright rays, and all the stones struck in starry purple shine in value…to beautify small things, so that although confined in space, they surpass the large. Nothing is small to Christ. He, whose temples exist within the human heart, well occupies confining buildings.[29]

Light may not have been born this way, as Bishop Peter recognized, but it was certainly and skillfully captured in the glint and gleam and shine and shimmer of reflective tesserae, each igniting the next in a process that once begun did indeed reign free.

Notes

1 I would like to thank Liz James for her assistance in putting this paper together.
2 Terry and Henry Maguire studied these mosaics for a decade, both from scaffolding in several campaigns and through documents detailing their 19th-century restoration: A. Terry and H. Maguire, *Dynamic Splendor. The Wall Mosaics in the Cathedral of Eufrasius at Poreč, Volume One: Text; Volume Two: Illustrations*, University Park, Pennsylvania, 2007. In references below, page numbers refer to volume 1, plate numbers to volume 2.
3 See, for example, R. Cormack, *Writing in Gold*, London, 1985.
4 Avitus of Vienne, *Selected Letters and Prose*, trans. by D. Shanzer and I. Wood, Liverpool, 2002, Epistula 50, 327. Thanks to Peter Brown for suggesting looking at Avitus and Bishop Peter II.
5 Terry and Maguire (n. 2), 6, pl. 60.
6 See also the discussion in Terry and Maguire (n. 2), 110–11 (Eufrasius) and 100–1 (Virgin and Child).
7 For example, orange was used for highlighting faces, see Terry and Maguire (n. 2), pl. 7 (the Christ Child).
8 Terry and Maguire (n. 2), 81–2.
9 See ibid., 79–82.
10 I. Andreescu-Treadgold, 'The mosaic workshop at San Vitale', in A.M. Ianucci, C. Fiori and C. Muscolino (eds), *Mosaici a S Vitale e altri restauri: Il restauro in situ di mosaic parietali*, Ravenna, 1992, 3–4; also see Terry and Maguire (n. 2), 83.
11 Discussed in more detail in Terry and Maguire (n. 2), 82–8.
12 See ibid., pl. 24 (Claudius), pl. 34 (Eufrasius), pl. 40 (Maurus) and pls 45 and 46 (saint).
13 M. Roberts, *The Jeweled Style: Poetry and Poetics in Late Antiquity*, Ithaca and London, 1989.
14 Terry and Maguire (n. 2), 93, pl. 27.
15 Ibid., 91 ('crow step), 199 (figure of eight), and pl. 98 (Gabriel).
16 Ibid., pl. 39.
17 Ibid., pls 33 and 126.
18 L. James, *Light and Colour in Byzantine Art*, Oxford, 1996.
19 Terry and Maguire (n. 2), pl. 126 (Visitation) and pl. 107 (Zacharias).
20 Ibid., 97–8.
21 Ibid., pls 7 and 182.
22 Ibid., pls 107, 110, 111.
23 Ibid., pl. 150.
24 Procopius, *The Buildings*, 1, 1.47–8, ed. and trans. by H.B. Dewing, *The Buildings*, Harvard and London, 1940.
25 Sidonius Apollinaris, *Carmina* 2.420–1, ed. A. Loyen, *Opera*, Paris, 1960–70; Roberts (n. 13), 23.
26 Procopius, *Buildings*, 1, 1.XXX.
27 Fortunatus 2.10. 15–16, trans. by M. Roberts, *The Humblest Sparrow: The Poetry of Venantius Fortunatus*, Ann Arbor, 2009, 65.
28 I.15.57–8 in Roberts ibid., 66.
29 Peter's inscription is quoted by Agnellus of Ravenna in his *Liber pontificalis ecclesiae Ravennatis*, ed. D.M. Deliyannis, Turnhout, 2006, ch. 50. This translation is that of D.M. Deliyannis, *Agnellus of Ravenna. The Book of Pontiffs of the Church of Ravenna*, Washington DC, 2004, 162.

Chapter 19 **Experiencing the Light** Byzantine Church Window Glass and the Aesthetics of Worship

Claire Nesbitt

This paper considers the evidence for Byzantine church window glass; it examines glass not simply as part of the aesthetic fabric of buildings or as an indicator of status, but as part of the architectural staging for the experience of worship. Glass had a significant impact on natural light transmission; light is arguably one of the most significant factors in shaping the architecture and cultivating ambience during the liturgy. I will bring together existing research on glass to understand its contribution to the experience of churches and will demonstrate the Byzantines' understanding of both the functional and aesthetic properties of glass.

Introduction

The study of Byzantine glass has traditionally focused on glass vessels and has tended to be dominated by scientific analysis. The glazing of windows in the Byzantine period has, until recently, been a neglected area of study. Window glass is poorly represented in the archaeological record; where it has been discovered it is often summarized briefly as part of a broad ranging report detailing all glass finds.[1] As a result, little attention has been devoted to considerations of the form and use of window glass. In recent years the balance has shifted, window glass is being more carefully recorded in excavations, and assemblages such as those from the churches of Zeyrek Camii and Kariye Camii in Constantinople have generated greater interest in the material; however, more work is still needed to understand fully the Byzantine use of window glass. This paper takes the view that window glass should not be considered in isolation, but rather should be seen as part of the dramatic materiality of the Byzantine church that shaped the experience of worshippers.

I will argue that window glass formed a fundamental part of the fabric of the building and, more importantly, contributed significantly to the creation of experience within the church. As the focal point of religious practice in a society where church and state were inextricably linked, the Byzantine church was the place where individuals met with the official representation of their faith. The experience of worshippers in the church building would have been central to their understanding of faith, society and their own place within each. It is unsurprising, then, that so much effort was dedicated to the creation of sacred architecture. One of the most important factors in shaping the experience of worship was the manipulation of the light inside churches.[2] The levels of light experienced in Byzantine churches have until recently been a matter of little concern. It has been a widely acknowledged truism that the interiors of Byzantine churches were relatively dark. Recently however, research has been undertaken to discover original levels of light in sacred architecture in more specific terms and perhaps more importantly, the architectural, aesthetic or liturgical design behind these light levels.[3] From the Early to Middle Byzantine period, the area of church windows allowing natural light to enter churches was reduced to around 33%;[4] this reduction would have had a dramatic affect on viewers' perception of the interior. With limited daylight, the quality of light inside the churches depended heavily on window closures and glazing.

The aesthetic properties of glass and its role in church architecture have been considered in terms of glass tesserae in mosaic decoration[5] and its contribution to aesthetics inside the Byzantine church.[6] Francesca Dell'Acqua's work has highlighted the need for attention to the use of window glass in Byzantine architecture; I will build on this research to offer a chronological development of window glass and an understanding of the styles used in Byzantine church architecture.

This paper will argue that Byzantine architects had very clear specifications for window glass which had to be fulfilled if the glass was to play its part in the creation of a sacred atmosphere for worship. I will consider the evidence for glazing in church windows in the Byzantine East in the context of the liturgical role of the church building. Approaching the glass evidence in a holistic manner as part of the fabric of the church, rather than in terms of technological development will give an insight into the importance of glass in shaping the overall light levels in churches and cultivating the sacred environment.

Form and function

The potential for natural light to enter the Byzantine church was determined by the size of the windows; the extent to which the windows achieved this potential for lighting was in turn determined by the nature of the window closures. Sources attest to the use of a variety of materials as window closures such as carved marble slabs (*phengites*) thin enough to transmit light at Hosios Loukas and alabaster used in a similar way in the Mausoleum of Galla Placidia, Rome.[7] In the early Imperial period, glass windows were luxury items and evidence points to the existence of cheaper alternatives. Early substitutes were shutters, gratings or lattices of pottery, wood, stone, marble, gypsum, or selenite which was used in the church of Santa Sabina on the Aventine Hill, Rome.[8] These materials would have had a significant impact on the levels of light penetrating the windows. In the event that the windows were glazed, and this becomes increasingly common in the Late Antique and Early Byzantine period, the quality, colour and thickness of glass window panes all determined the amount and quality of light entering the church. Understanding the properties of glass was crucial to controlling the light. By examining the ancient sources, we gain an insight into how glass was used and developed according to its functional and aesthetic properties.

Window glass first appears in the ancient sources in the 1st century when Pliny and Martial independently refer to what appear to be greenhouses. Pliny describes a frame into which *specularia* (window panes) were fitted to facilitate the growth of cucumbers and Martial cites a similar arrangement.[9] This is followed by Seneca at around the same time who reports that window panes were a common feature of bath houses at this time.[10] The contexts of these references reveal that the Romans employed glass or translucent material because it would allow light to penetrate into an area without exposing the interior to the elements.

It is clear that glass was used extensively for windows in the early Roman period, predominantly in bath houses.[11] In these buildings we can begin properly to identify a functional purpose in the use of glass. Using glass in windows not only allowed natural light into the building, but also insulated the baths, keeping warm air inside. Evidence from Herculaneum suggests Romans baths were sometimes double glazed; two wooden frames appear to have held glass window panes approximately 80cm^2. The frames were spaced 10cm apart to form a double glazed window. Furthermore, north-facing windows were fitted with wooden shutters presumably as further protection from the elements.[12] Further evidence is found in the baths of Neptune at Ostia in which a heated corridor ran the length of the north side of the caldarium with glazed windows along each side, providing light for the caldarium but also a cushion of warm air to insulate against the cold.[13] As well as serving a practical function, glass windows had an aesthetic role in this context. It was important for bathing to be luxurious and enjoyable; Seneca comments on the Neronian thermae: 'Today we call the baths louse-holes if they are not designed to attract the sun all day through picture windows, unless men can bathe and acquire a sun tan simultaneously, and unless they have a view over the countryside and the sea from their pools.'[14]

In the Early Byzantine period evidence from texts reveals further insight into the understanding of glass. Paul the Silentiary, writing in the 6th century of Justinian's Great Church of Hagia Sophia, reveals not only that the windows in Hagia Sophia were glazed with glass, but that the aesthetic effect produced by the glass was noted and, it seems, appreciated: 'and through five-fold openings, pierced in its back, filled with thin plates of glass, comes the morning light scattering sparkling rays'.[15] Rosemary Cramp demonstrated that there was a similar appreciation of the effect of glass on the interior lighting of churches in Anglo-Saxon Britain. She cites an early 9th-century poem, *De Abbatibus*, which describes how the glass windows in a Northumbrian church transmitted and diffused the light of the sun: 'This is the house lofty and with long walls, which the shining sun illuminates through glass windows, diffusing soft light in the bright church.'[16] In the 12th century, writings by Nikolaos Mesarites describe how window panes were inserted into a framework of wooden crosses and received the light of the sun to illuminate the church.[17] The evidence is fragmentary and incidental, but suggests that from as early as the 1st century, and certainly by the Middle Byzantine period, the properties of glass were clearly understood, along with how to exploit it to its maximum advantage. Architects and builders of Middle Byzantine churches, then, belonged to a cultural background that understood and appreciated the functional and aesthetic properties of glass.

Early Byzantine glass

In order to understand the impact of light on the interior of church buildings, we need first to understand the nature of glass, and it is necessary to revisit evidence from the archaeological record. Despite the comparative dearth of evidence for window glass, the gradually increasing corpus of material enables tentative steps towards an understanding of the nature of glazing in churches. One considerable assemblage was excavated between 1992 and 1996 at the Great Church at Petra, Jordan. Glass fragments discovered

include window glass dating from the 5th to 7th century. Two distinct types of glass survive from the church, blown round windows with folded rims, and square or rectangular panes.[18] The surviving glass had a limited range of colour: transparent to translucent aqua-blue, yellowish-green and dark bottle green.[19] The bluish green rectangular panes discovered at the Petra Church average 0.2–0.3mm thick and are not more than 12cm in length. They appear to be cut from larger panes as they have both fluid edges and chip-bevelled edges. These panes are consistent with other 6th-century examples from Byzantine churches in the area such as the monastery of Beit She'an, the church at Shavei Zion, the church at Rehovat and Khirbet ed-deir.[20] The olive green panes are the same size and manufactured in the same way as the rectilinear glass.

The Petra assemblage was analyzed by Nadine Schibille, Fatma Marii and Thilo Rehren whose examination of the glass suggests that it was probably originally transparent or almost transparent.[21] The analysis undertaken on the Petra glass included optical absorbance spectra to assess the amount and quality of the light transmitted through the glass. The results of this analysis revealed an interesting relationship between the level of light absorption and the thickness of the glass, namely that the thinner the glass, the less light was absorbed and the more light was transmitted.[22] These glass fragments were also found to absorb light equally across the visible range of the spectrum; what this means, in terms of how the light is perceived by the human eye, is that light transmitted through the glass is white or colourless.[23] Schibille noted that where the glass was thicker, the light it transmitted had a greenish blue tinge because it absorbed more light.[24] The light transmission of the glass from the Petra Church fell into the range recognized to be the maximum efficiency of photopic vision which allows accurate colour perception,[25] suggesting that the glass was providing the best possible lighting for the church. The fundamental principle appears to be that the thinner the glass, the more light and the better the quality of light that enters the building. This lends weight to Dell'Acqua's argument that the Byzantines' use of colourless glass was quite deliberate so that it did not compromise the colours of the mosaics, frescoes and icons within the church.[26] With this premise in mind, it is possible to revisit other glass assemblages to discover whether it is possible to identify a trend for glazing that facilitated light.

Further evidence for Early Byzantine window glass in the archaeological record survives from the church of St Polyeuktos (Saraçhane) in Constantinople, excavated by Martin Harrison in the 1960s. It is believed that the church was built in the 6th century by Anicia Juliana, daughter of the western Emperor Olybrius and a high-status individual, and connected to Anicia Juliana's palace.[27] With such a wealthy benefactor we would expect it to utilize the highest quality materials and perhaps reflect the contemporary 'ideal' in church architecture. The excavations turned up a relatively small number of glass fragments considering the quantity of surviving window mullions, leading Harrison to suggest that the glazing of the church was never fully completed. There is no suggestion that this would have been deliberate and if the church was not fully glazed, it was probably unfinished.[28] More likely is that at some point the building was stripped of its glazing for recycling, perhaps as cullet.[29] Cecil Striker noted a similar absence of window glass at the Kalenderhane Camii in Constantinople where no glass attributable to the main church was found in excavations;[30] this complete absence of glass fragments suggests deliberate and methodical removal rather than poor preservation, where we would expect at least some fragments to survive.

Fragments of window glass discovered at St Polyeuktos were circular and rectangular panes in various colours from colourless through to blue-green and olive to brown.[31] Placing the glass into a chronological framework is problematic; although glass was present in several different contexts from the 5th- to 6th-century levels through to the 16th-century levels, only the 7th-century level, some of the Middle Byzantine levels and the 16th-century level are securely dated, the other levels are contaminated or mixed and it is therefore difficult to say with any certainty to which period the glass in those contexts belongs.[32] Most fragments were discovered in the 7th-century level and the securely dated Middle Byzantine levels, with the majority belonging to 11th- and 12th-century contexts. Approximately 200 fragments of window glass were discovered in the mid-7th-century levels and around 300 fragments from the 10th to 13th century levels. **Figure 1** shows the context and characteristics of the fragments.

All of the window glass fragments from the mid-7th century context are rectangular; crown glass does not appear in a securely dated level until the 10th century. The colour of glass from the mid-7th to 13th century at St Polyeuktos does not change drastically. Leaving aside the fragments of uncertain date, the colours of the 7th century and 10th to 12th century glass are shown grouped broadly into blue-greens, olives, browns and colourless glass in **Figure 2**. The results show that the colours are all used in both Early and Middle Byzantine church windows. The differences that emerge between the periods are that there is more colourless glass from the Early Byzantine period than the Middle Byzantine and the majority of the glass is olive coloured in the Early Byzantine levels, while the majority of fragments discovered from the Middle Byzantine levels are shades of blue-green.

These results, however, are only representative of the extant evidence which can be securely dated and **Figure 3** shows how the graph changes if the fragments from the levels of uncertain date are included in the data set. The results still show a relatively even distribution of colour across the periods of use with a predominance of blue-green or olive being the only major difference. It is clearly not possible to be too bold in assumptions about the nature of the glazing from the extant fragments; they do not represent the amount of glass required to glaze a building of this size. However, it is possible to make a few observations. While there is a distinction between the date of the rectangular and crown panes of glass, the colours in which they were produced are similar. There are three possible reasons for this: either crown glass was introduced to the church while rectangular glass was still in place and was required to

Fragment shape	Date of Context	Colour	Thickness	Size
Crown Glass	Late 5th/Early 6th Late 12th/ Early 13th	*Tp* Brown, medium Brown, dark brown, yellow-brown, *tp* dark olive green, *tp cl*, *cl* slightly pink, *tp* blue-green	1-1.5mm at rim	32-36cm diameter
Rectangular	Late 5th/Early 6th Late 12th/ Early 13th	*Tp* bluish-green, tp pale olive green, *tl* olive green	2-5mm	18 x 18 cm
Rectangular	Mid 7th	Pale almost *cl*, pale yellowish brown, pale olive green, medium olive green, blue-green, pale blue	2mm	No dimensions
Rectangular	Mid 7th	Pale almost *cl* pale brown, pale yellowish brown, pale olive green, medium olive green, pale green-blue, green blue	1.5-2mm	No dimesions
Rectangular	Mid 7th	Dark and medium olive green, pale almost *cl* pale brown, pale yellowish brown, pale olive green, pale olive, medium olive, dark olive, pale blue green, greenish blue	3mm 1.5-2mm	No dimesions
Crown	11th - 12th	*Tp* blue green, dark olive green	2mm	36cm
Rectangular	11th -12th	Pale yellowish, *tp* brown, yellowish brown, *tp* bluish green	3-5mm	No dimensions
Crown	10th-12th	Blue-green, dark olive green, dark brown	No dimensions	No dimensions
Rectangular	10th-12th	Bluish green, very pale olive green	No dimensions	No dimensions
Rectangular	10th-11th Early 12th	Bluish green, pale olive green	1.5-5mm	No dimensions
Crown	10th-11th Early 12th	Bluish green, pale olive green	1.5-5mm	No dimensions
Crown	Mid 12th	Blue green, dark olive green, pale olive green, very pale almost *cl*	1.5mm	30-32cm diameter
Crown	13th	Dark olive green, medium olive green, blue green, bluish green	1.5-5mm	26-30cm
Circular (not crown)	13th	Dark brown	4.5mm	30cm diameter
Crown	Mid 16th	*Cl* Pale yellowish	3.5-4mm	22cm diameter

Tp = Transparent, *Tl* = Translucent, *Cl* = Colourless

Securely dated level | Mixed Level | Contaminated Byzantine Level

Figure 1 Table showing the character, context and date of glass fragments from St Polyeuktos, Constantinople

match; or technology was such that these were the only available colours; or crown glass was not produced to complement the existing colour scheme at all, but these were still the preferred colours. The second possibility may be discounted on the grounds of the evidence from Zeyrek Camii and Kariye Camii, both of which had a diverse range of colours in the fragments of glass discovered in Middle Byzantine contexts demonstrated by Robert Brill to have been made in the Byzantine East.[33] The other two possibilities both suggest a colour preference across the period.

Figure 4 shows the range of colours of all glass fragments isolated by form and date. The graph shows that in the Early Byzantine period the colours used are all pale: very pale olive green; pale olive green; yellowish brown; medium olive green; pale blue-green; blue-green, and colourless. These colours are pale and thus transmit more light than darker glass. This is consistent with the large fully glazed windows of the Late Antique and Early Byzantine periods which allowed light to flood the buildings. The colours of fragments from Middle Byzantine levels are: colourless; very pale olive-green; pale olive-green and blue-green, with only two fragments of dark olive and one dark brown. These colours also reflect the need for windows to transmit light. The blue-green glass is closest to colourless, which transmits the maximum amount of light; 65% of the fragments from the Middle Byzantine levels are blue-green. A further significant point which becomes clear from the evidence at St Polyeuktos is that many of the fragments are very thin, mostly between 1–3mm and not more than 6mm thick. Glass from the securely dated Early and Middle Byzantine levels all appears to be less than 3mm thick. Taking into account the evidence from Schibille, Marii and Rehren's study, this suggests that the glass that was used to glaze the church of St Polyeuktos was good quality and clearly allowed the effective transmission of light.

In Amorium, western Turkey, glass was excavated from the site of the Lower City Church, a building with two phases of construction, one from the late 5th to early 6th century and the second between AD 850 and 950.[34] This glass is believed to represent the Late Antique and Byzantine phases of construction, however it was all found in the same context: the medieval Turkish occupation of the church.[35] In total 550 fragments of window glass were discovered at Amorium. The colours are all pale shades including olive, bluish-green, yellow, brown, light green, green and

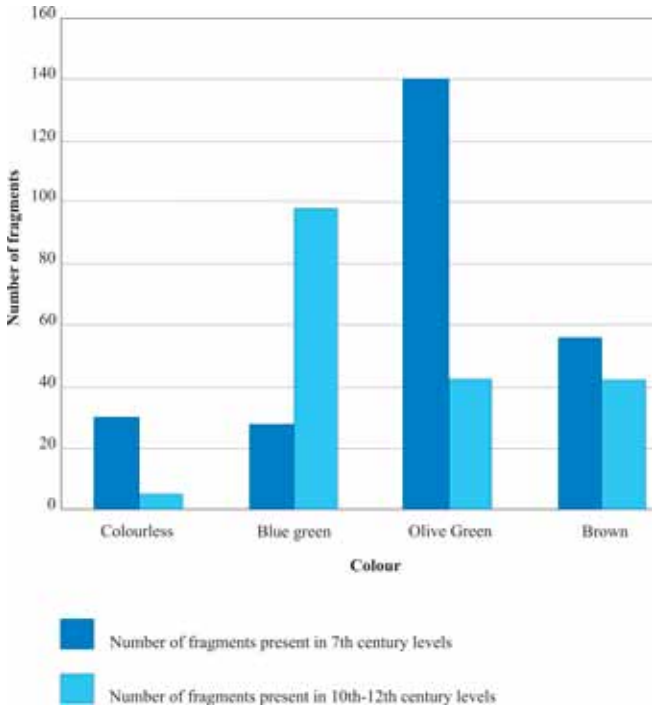


Figure 2 Graph showing broad colour groups of glass fragments from the Early and Middle Byzantine levels at St Polyeuktos, Constantinople

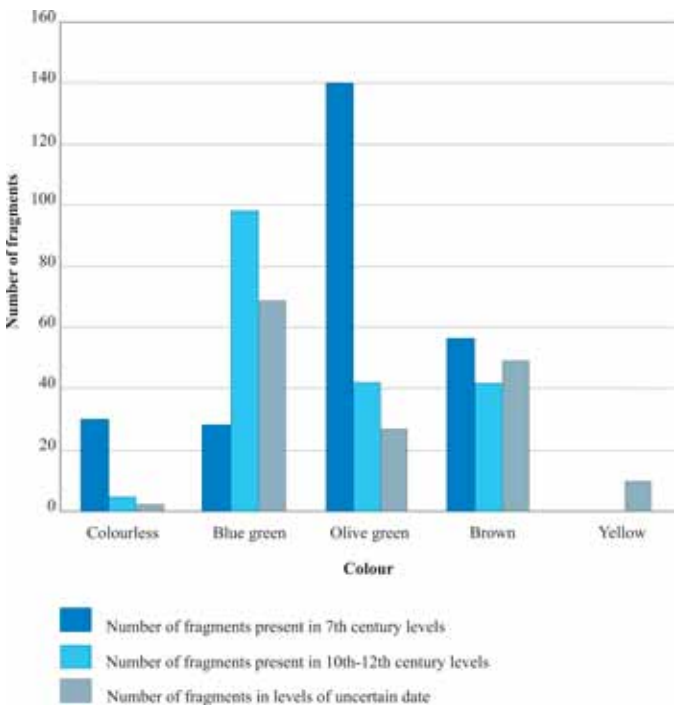


Figure 3 Graph showing broad colour groups of glass fragments from all levels at St Polyeuktos, Constantinople

colourless. The thickness varies from 2–5mm.[36] The report suggests that the only glass found in the contexts of the Lower City Church was crown glass in bluish-green, colourless bluish-green, light green colourless and one example of colourless purple.[37]

Although the Early Byzantine levels at Sardis in Turkey provided a wealth of glass window panes, their location suggests that the majority were stock from the Byzantine shops[38] and there is no evidence for Early Byzantine window glass from a church context. However, Axel Von Saldern has suggested that all window glass belonging to the Middle Byzantine levels at Sardis should be associated with Church E.[39] Church E was the third church constructed on that site; the last construction phase belonging to the 13th century.[40] While Von Saldern recorded only around 30 window pane fragments,[41] Hans Buchwald recognized over 100 fragments

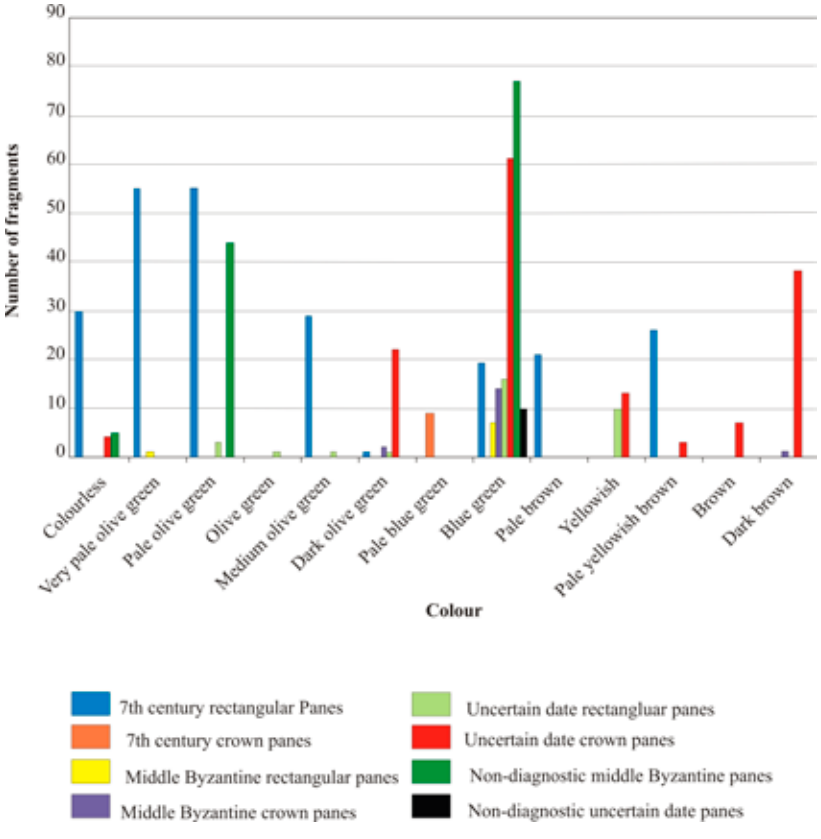


Figure 4 Graph showing the colour and characteristics of glass fragments from all levels at St Polyeuktos, Constantinople

of window glass from the church.[42] These fragments were coloured pale blue, black-blue, blackish-purple, pale yellow green and olive; some or all of the fragments may be crown glass, with thickness varying from 1.5–6mm.[43] Coloured glazing is not usual in Byzantine buildings,[44] but could have lent an air of luxury to the church, and may have replaced what seems to have been the standard colourless glazing in earlier churches.[45]

The conclusions we can draw from Early Byzantine glass fragments from Petra, St Polyeuktos and Sardis are as follows. In the Early Byzantine period there was a higher representation of very pale olive-green and colourless glass. In the Middle Byzantine period there were more blue-green fragments. While colourless and olive coloured fragments are found in Middle Byzantine levels, they are not present in as great a number and may represent residual evidence of glass surviving from the early period. In terms of interior decoration of the church there is a limited amount of evidence on which to base any suppositions. This makes it difficult to speculate on whether the darker coloured glass fragments discovered at Church E would have had an impact on coloured interior decoration. While no recognizable figure representations survive, small fragments of frescoes and numerous coloured and gold glass tesserae typical of those used in mosaic decoration were found in the excavations.[46] Sardis was not the only church to have used darker coloured glass (see below). The question is, to what effect was this glass used and how did it affect the lighting scheme of the church?

Changes in the Middle Byzantine period

Glass finds from both Zeyrek Camii and Kariye Camii pose a problem for the argument that glass was deliberately made thin and colourless to allow light into the church. These fragments appear to defy everything we know about Byzantine window glass. Stained with dark colours, painted with geometric, literary and figured imagery these fragments are unique among examples of Byzantine window glass.

The original construction of Zeyrek Camii (Pantocrator monastery) dates between 1118 and 1136 and like St Polyeuktos, it is an example of a building commissioned by the imperial family; the patron of this church is still debated and opinion is divided between Empress Irene and Emperor John II.[47] The glass fragments discovered at the monastery caused much debate because of their unusual characteristics. The fragments were discovered in the apse area of the south church, which dates between 1118 and 1124. Initially examined by A.H.S. Megaw who described the glass as cast,[48] it has more recently been identified by Dell'Acqua as cylinder blown. It exists in five different colour groups: blues; amber yellows; emerald green; purples; and pink. There are also colourless fragments which represent 24% of the total sample.[49] The assemblage includes coloured painted fragments, coloured unpainted fragments and colourless unpainted fragments; of these over half are colourless and unpainted and around a quarter are coloured but unpainted. The painted fragments vary between 2–5mm in thickness while the unpainted fragments are thinner averaging 1mm in thickness. Megaw suggested that the glass represented two separate glazing systems in the church, one which used painted glass and one which did not.[50]

The apse window in Zeyrek Camii is 8m high, the centre light is 1.4m wide and the lateral lights are 1m wide. It is believed that the small amount of glass found during the excavations came from these windows.[51] Fragments of the glass in a skin colour, fragments with painting suggesting folds of fabric, and most importantly a fragment depicting a human eye, all indicate that the glass depicted a human form. Megaw estimated that each of the window lights could comfortably accommodate three figures, which, with three lights, would create space for nine figures altogether, though this estimation is thought rather generous by other scholars.[52] The extant glass provides evidence for only three figures, of which Megaw has tentatively identified Christ and Mary.[53] Megaw initially argued that while the glass was similar in character to western glass,[54] it was in fact Byzantine and produced by local artisans. This conviction was derived from the fact that one of the fragments of glass is painted with a Greek letter 'Y', suggesting that it was not created by a Latin craftsman. Furthermore, there is no other evidence that the Latins made any alterations to the building during the occupation other than removal of liturgical furnishings. Megaw also believed that the colours of the glass lent further support to his argument; the amount of blue glass and its intense colour is indicative of a Byzantine workshop. He cites Theophilus' treatise on the arts in support of this. Theophilus suggested that in the West, blue glass was difficult to make and that it was a Greek speciality.[55]

Megaw subsequently revised his assessment of the glass acknowledging that it may belong to the Latin occupation.[56] A comparison between contemporary glass windows of East and West reveal a significant difference in the two styles. If the 12th-century windows of Canterbury Cathedral are compared with eastern window glass, even the figured window glass of Zeyrek Camii, the difference in style is clear. The figures in the windows at Canterbury are much smaller and lack the characteristic Byzantine style especially in the facial features. For a long time the glass divided scholars between those who would claim it for the Byzantines and those who saw it as a western production. Recently Robert Brill laid to rest at least some of these arguments by undertaking chemical analysis of the glass. He concluded that the Zeyrek Camii glass was not made in western Europe, having a composition that matches eastern Byzantine glass. While convinced that the glass was produced in the Byzantine world, probably not far from Constantinople, Brill acknowledges that this tells us about the manufacture of the glass, not necessarily where it was formed into windows and painted.[57] Before making concluding remarks on this glass, it is appropriate to consider another sample of coloured glass from Constantinople, that from Kariye Camii.

The assemblages of glass from Kariye Camii were discovered during the 1957 excavations in the bema of the main church, and also at the east end of the parekklesion.[58] The glass from the bema area was similar in its physical character to that of Zeyrek Camii. The sample is smaller than the Zeyrek Camii assemblage but still includes

coloured unpainted, coloured painted and colourless glass.[59] The colours are similar but weaker than the colours of the Zeyrek Camii glass, but like the Zeyrek Camii glass the Kariye Camii assemblage includes fragments with Greek letters painted on them, in this case a 'K' or an 'X' and an 'O' or a 'C'.[60] The glass discovered in the parekklesion was colourless, and found in association with lead cames. It may have belonged to the apse window in the parekklesion in which three stucco transennae were discovered *in situ*.[61] Some of the unpainted fragments from Kariye Camii appear to be parts of crown glass panes, more typical of Byzantine window glass than the stained glass fragments.[62]

The colour of the glass, the presence of figured images and lead cames have led some scholars such as Harden and Lafond to date these windows to the 13th-century Latin occupation and to conclude that even though the glass may be Byzantine, the painting is in a western style by a western artist.[63] In his 1963 report, Megaw suggested that the glass from Kariye Camii probably came from a similar window arrangement to that at Zeyrek Camii which he believed to be large coloured windows with life-size figures set in ornamental borders. Though the glass was not identical to that at Zeyrek Camii, he believed the differences were no more than one might expect between two contemporary workshops.[64] Megaw concluded that the glass from Kariye Camii and Zeyrek Camii was roughly contemporary, placing both assemblages in the Komnenian period, with the Kariye Camii glass around 20 years earlier than that from Zeyrek Camii. He also proposed that the glass was made by Byzantine craftsmen and was probably the original early 12th-century glazing of the churches.[65] While Megaw revised his opinion on the Zeyrek Camii glass, he maintained his position that the Kariye Camii fragments represent the initial Byzantine decoration of the church.[66] Dell'Acqua prefers a date in the late 12th century under Manuel Komnenos (1143–80), noting that Manuel's two marriages to western women created a connection with the West which could explain the western inspiration for the window design at Kariye Camii.[67] Furthermore, she points out that there is no precedent in Byzantium for the grisaille window style evident in the Kariye Camii glass.[68] Some have argued that a painted disc of glass discovered in excavations at San Vitale, Ravenna, sets a precedent for the use of painted figural glass in a Byzantine monument;[69] others have questioned the date of the glass from San Vitale. Dell'Acqua has argued that as well as being inconsistent with the 6th-century window frames of the basilica at San Vitale, which were probably wooden grilles designed to hold rectangular glass comparable to those at Sant'Apollinare in Classe, the disc also employs artistic technology not known in the 6th century. She prefers instead a date between the 9th and 10th centuries, during a Benedictine occupation of the site.[70]

Chemical analysis of some of the coloured glass from Constantinople was undertaken and was published in 1995 by Marlia Mundell Mango and Julian Henderson[71] and more recently by Brill (2005).[72] Mundell Mango and Henderson conclude that the glass was distinctly different to 12th-century western glass, which has much lower potassium levels, and also different to Islamic glass; Constantinople and the West used entirely different manufacturing processes and the artisans were unlikely to have influential contact with each other.[73] Brill's analysis presented similar results revealing the glass to be of eastern origin.[74] While at face value this lends support to Megaw's argument that the glass is Byzantine, Dell'Acqua has rightly argued that the glass could have been re-used Late Antique or Early Byzantine glass, reworked by western artists.[75]

The evidence is not conclusive on whether the glass was the original glazing of either church. Dell'Acqua has argued convincingly that the windows were experimental and in all probability involved the participation of western artisans.[76] She points to Robert Ousterhout's 1999 work which has demonstrated that the Komnenian dynasty had strong links with the West, and subscribes to a Komnenian chronology for the Zeyrek Camii glass.[77] Whatever their origins these fragments remain the only known examples of their kind. This would suggest either that the windows were too expensive to become commonplace in churches, or that craftsmen with appropriate skills did not continue their work in the Byzantine East, having perhaps been drafted in from the West especially for the Komnenian imperial church windows. Apart from these examples the windows in Middle Byzantine churches are almost exclusively glazed with roundels of glass set in perforated screens.

It appears that the same glazing practices continued into the Late Byzantine period. Churches in Athens and Thessaloniki share the same pattern of perforated screens with crown discs set in them. Parallels are also seen in the early 14th-century church at Gračanica; Slobodan Ćurčić described the colourless glass window discs as resembling 'bottle bottoms' which varied in diameter from 6cm to 16cm. The original glazing was preserved in two places: in the upper parts of the triple window of the main apse and in the western single window of the north façade. The window panels were reconstructed during a conservation project undertaken on the church and were based on the preserved originals.[78] Further evidence for the continuation of the same glazing scheme comes from another 14th-century church at Lesnovo, built in 1341, which maintains several original windows.[79] Each window contained approximately 20 round discs, arranged in two rows. Several of the discs were overlaid with decorative patterns in lead which may have been a measure to hold them in place. The church also boasts a further three complete surviving windows made with stucco frames; these windows have only a single row of discs but are made more elaborate by triangular pieces around the edges and a half oculus at the top.[80] The trend for pierced panel windows with circular discs of glass, then, has a demonstrable longevity in Byzantine churches.

Glass and the aesthetics of light

In terms of allowing light into the church, the glass from both Zeyrek Camii and Kariye Camii introduces a new dimension to the otherwise apparently standard pattern of glazing in Middle Byzantine churches. Apart from this glass, all the evidence for Byzantine glass points to small roundels of crown glass which were pale coloured with darker coloured glass being the exception.[81] Paler coloured, thin

glass, as has been discussed above, allows more good quality (i.e. white) light to enter the building. The trend for this scheme of glazing makes the darker coloured heavily painted glass from Kariye Camii and Zeyrek Camii still more anomalous. A crucial point to note is Megaw's observation that the pictorial glass and the paler, thinner unpainted glass appear to have belonged to separate systems of glazing.[82] This theory was expanded by Dell'Acqua who suggests that the two kinds of glazing may have been contemporary and perhaps reflected a hierarchy of glazing in which the most significant areas of the church were afforded the most elaborate glass.[83]

I would take this argument a step further and suggest that as well as being part of a hierarchical scheme of glazing, the stained glass from Constantinople can be seen as an extension of the Byzantine repertoire of iconographic media in churches. What we are seeing could be the remains of 'icons in glass'. As Megaw states, there are parallels between the style and patterning on the glass fragments from Zeyrek Camii and the background of icons from St Catherine's, at Mount Sinai and San Marco, Venice.[84] The Byzantines created icons in every other medium: paint; mosaic; ivory and enamel – a form of glass – so why not in glass windows? It has been argued that figured windows may in some way compete with or detract from the iconographic programme of the church.[85] However if what is represented by the Zeyrek Camii and Kariye Camii glass is indeed two separate glazing systems then it is possible to see the figured windows as a centrepiece, in line with Dell'Acqua's hierarchy. Rather than a church fully glazed with coloured glass which would 'taint' the perception of colour for the viewer, the artists may have used predominantly colourless thin glass in most of the church and then placed the iconic figures in windows as a focal point. In this way, the glazing scheme in the church would, in a sense, reflect the traditional iconographic programme of the Byzantine church, simply expanded in another media. My own research has shown that the levels of light in church buildings were reduced in the Middle Byzantine period, in order to better control the liturgical spectacle within the church.[86] Having an icon in glass, illuminated from behind by natural daylight, would be entirely in keeping with the practice of illuminating icons for devotion. Alice-Mary Talbot has noted a 14th-century text written by John Aktouarios describing the nature of windows.[87] In the text Aktouarios states that: 'after setting pieces of glass of various colours in windows, we see the rays of light that enter from outside through them bringing to the glass the qualities of bright colours, while [the rays] themselves remain unchanged in themselves and uncoloured'.[88] This source attests to the use of coloured glass in windows in the Late Byzantine period, and also suggests that rays of light remain uncoloured. This could reflect the ability of the human eye to compensate for changes in light and colour and 'rebalance' visual perception accordingly. It could also suggest that the coloured windows at Kariye Camii and Zeyrek Camii were not as unique as they appear.

Conclusion

Thinking of glass in terms of dramatic materiality, we can see that this was potentially used to tremendous effect in the stained glass from Zeyrek Camii and Kariye Camii, where the light transmitting properties of the glass appear to have been sacrificed for a different visual aesthetic effect. Here the glass becomes almost a vessel to hold the light as the window, with the sunlight behind it, would appear to glow. Dramatic effects in the arrangement of church architecture and decoration exploit the association between light and the sacred. The glazing of the windows is crucial to maintaining this ambience and to the creation of an architectural stage against which the liturgy would have been performed. It is possible to argue that in the Middle Byzantine period when windows were becoming smaller, with a smaller glazed area, it became important to use pale, thin good quality glass which would transmit the daylight without tainting the polychrome decorative programme within the church. In addition to this the use of coloured glass may have featured in iconic centrepiece windows like those evident at Zeyrek Camii and Kariye Camii.

It seems clear that the Byzantines inherited a culture of understanding the properties of glass and its architectural uses. They could draw on examples from Roman bath houses, designed to be light, bright and warm; they could look to Late Antique basilicas with arcades of glazed windows flooding the interior with light. The technology was in place to allow the architects of Middle Byzantine churches to reduce the size of the windows in the church, yet still provide sufficient quality of light to create the desired light effects within the church.

Glass window screens and multicoloured revetments in the complex arrangement of ecclesiastical decoration had an important role.[89] Dell'Acqua rightly sees glass not as an individual and dislocated feature of the architecture but as 'part of an architectonic "system" dependent upon precise static exigencies, functional as well as aesthetic'.[90] She has also argued convincingly that because the interiors of many Byzantine churches were decorated with figural mosaics, carefully executed in particular colours, the preferred glazing medium was probably something that would not contaminate or mask their colours.[91]

I have argued elsewhere that the amount of natural light in churches was being reduced in the Middle Byzantine period;[92] the evidence for window glass in the archaeological record makes it clear that while less light was required, the light that was transmitted through the windows was required to be of good quality, by that I mean white light which is best for viewing. All the evidence points to the conclusion that the architects of the Middle Byzantine church were aiming to maintain a certain level of natural light within the building. It also reveals a clear understanding of the properties of glass and a familiarity with technology that allowed flexibility and diversity of choice. Though our understanding of Byzantine window glass is still developing, it is clear that glass had a crucial role in the overall aesthetic visual experience and perhaps also the spiritual devotional aspect of Byzantine worship.

Acknowledgements

This paper was written as part of the research for my PhD thesis which was funded by the Arts and Humanities Research Council. I am grateful for their support. I would

like to thank Liz James for commenting on earlier drafts of this paper.

Notes

1 D. Whitehouse, 'Window glass between the 1st and the 18th centuries', in F. Dell'Acqua and R. Silva (eds), *Il Colore nel Medioevo*, Lucca, 2001, 31–40.
2 C. Nesbitt, 'Shaping the sacred: light and the experience of worship in Middle Byzantine churches', *Journal of Byzantine and Modern Greek Studies* 36/2 (2012), 139–60.
3 L. James, *Light and Colour in Byzantine Art*, Oxford, 1996; L. Theis, 'Lampen, Leuchten, Licht', in C. Stiegemann (ed.), *Byzanz, Das Licht aus dem Osten, Kult und Alltag im Byzantinischen Reich vom 4 bis 15 Jahrhundert, Katalog der Ausstellung im Erzbischoflichen*, Mainz, 2001, 53–64; N. Schibille, 'Light in Early Byzantium: the Church of Hagia Sophia in Constantinople', unpublished PhD thesis, University of Sussex; A. Piotrowski, *Representational Function of Daylight in the Katholikon of Hosios Loukas*, Available at: http://www.byzantinecongress.org.uk/paper/VII/VII.1_Piotrowski.pdf (Accessed: 17/10/06); Nesbitt (n. 2).
4 Nesbitt (n. 2).
5 L. James, 'Byzantine glass mosaic tesserae: some material considerations', *Byzantine and Modern Greek Studies* 30/1 (2006), 29–47.
6 F. Dell'Acqua, 'Enhancing luxury through stained glass, from Asia Minor to Italy', *Dumbarton Oaks Papers* 59 (2005), 192–211; F. Dell'Acqua, 'Reshaping the space, reshaping the natural light: the "Lower City Church" at Amorium (Anatolikon) between the fifth and eleventh centuries' Available at: http://www.byzantinecongress.org.uk/paper/VII/VII.1 _dell_acqua.pdf (Accessed 28/04/08).
7 R.W. Schultz and S.H. Barnsley, *The Monastery of Saint Luke of Stiris, in Phocis: and the Dependent Monastery of Saint Nicolas in the Fields, near Skripou, in Bœotia*, London, 1901, 25; G. Mackie, 'The Early Medieval chapel: decoration, form, and function: a study of chapels in Italy and Istria in the period between 313 and 741 AD', unpublished PhD thesis, University of Victoria, 1991, 165.
8 R.J. Forbes, *Studies in Ancient Technology*, Leiden, 1957, 181.
9 Pliny, *Nat. Hist.* 19.23: J. Bostock and H.T. Riley, *The Natural History of Pliny*, London, 1855, 2006; Martial, *Epigrams* 8.14: W.C.A. Ker, *The Epigrams of Martial*, London, 1919, 13.
10 Seneca, *Letters to Lucilius* 86.8: E. Phillips Barker, *Seneca's Letters to Lucilius*, Oxford, 1932, 44.
11 Whitehouse (n. 1), 35.
12 H. Broise,'Vitrages et volets des fenêtres thermales à l'époque imperial', in *Les Thermes Romains: Actes de la table ronde organisée par l'École française de Rome – Rome, 11–12 novembre 1988*, Collection de l'École française de Rome 142,Rome, 1991, 61–78, esp. 63.
13 Whitehouse (n. 1), 35.
14 *Letters to Lucilius* 86.8: Phillips Barker (n. 10), 44.
15 W.R. Lethaby and H. Swainson, *The Church of Sancta Sophia, Constantinople*, London, 1894.
16 R. Cramp, 'Anglo-Saxon window glass', in J. Price (ed.), *Glass in Britain and Ireland AD 350–1100*, London, 2000, 105–14, esp. 105: A.E. Campbell, *ÆTHELWULF: De Abbatibus*, Oxford, 1967, 50.
17 A.M. Talbot, 'Evidence about Byzantine glass in medieval Greek texts from the eighth to the fifteenth century', *Dumbarton Oaks Papers* 59 (2005), 141–6, esp. 144: A. Heisenburg (ed.), *Nikolas Mesarites, Palastrevolution des Johannes Komnenos* (Programm des königlichen alten Gymnasiums zu Würzburg), Würzburg, 1906, 34–5.
18 M. O'Hea, 'Glass from the 1992 Excavations', in Z. Fiema *et al.* (ed.), *The Petra Church*, Amman, 2001, 370–7, esp. 371.
19 N. Schibille, 'Analysis of Late Antique window-panes from the Petra Church in Jordan', unpublished MSc dissertation, University College London, 2005, 2.
20 Ibid., 23.
21 N. Schibille, F. Marii and Th. Rehren, 'Characterisation and provenance of the Late Antique window glass from the Petra Church in Jordan', *Archaeometry* 50/4 (2008), 627–42.
22 Schibille (n. 19), 27.
23 Ibid.
24 Ibid., 28.
25 Ibid., 60.
26 Ibid., 196.
27 R.M. Harrison, *Excavations at Saraçhane in Istanbul*, Princeton, 1986, 112; R. Krautheimer, *Early Christian and Byzantine Architecture*, London, 1986, 219.
28 Harrison (n. 27), 140.
29 Ibid.
30 C.L. Striker and D. Kuban (eds), *Final Reports on the Archaeological Exploration and Restoration at Kalenderhane Camii 1966–1978*, Mainz, 1997, 70.
31 R.M. Harrison and M.A.V. Gill, 'The window glass', in Harrison (n. 27), 204–6, esp. 204.
32 Ibid., 206.
33 R.H. Brill, 'Chemical analysis of the Zeyrek Camii and Kariye Camii glasses', *Dumbarton Oaks Papers* 59 (2005), 213–30, esp. 221.
34 C.S. Lightfoot and E.A. Ivison, 'Introduction', in M.A.V. Gill (ed.), *Amorium Reports, Finds I: The Glass (1987–1997)* (BAR Int. Ser. 1070), Oxford, 2002, 1–29, esp. 14.
35 Ibid.
36 Gill (n. 34), 101.
37 Ibid., 102.
38 A. von Saldern, *Ancient and Byzantine Glass from Sardis*, Cambridge, 1980, 92.
39 Ibid., 98.
40 H. Buchwald, 'Job site organization in 13th century Byzantine buildings', in S. Cavaciocchi (ed.), *L'Edilizia Prima Della Rivoluzione Industriale Secc. XIII–XVIII*, Prato, 2004, 625–67, esp. 626.
41 Von Saldern (n. 38), 101.
42 Buchwald (n. 40), 635.
43 Von Saldern (n. 38), 101.
44 Dell'Acqua 2005 (n. 6), 195.
45 Buchwald (n. 40), 650.
46 Ibid., 626.
47 Krautheimer (n. 27), 367; T.F. Mathews, *The Art of Byzantium*, London, 1998, 38.
48 A.H.S. Megaw, 'Notes on recent work of the Byzantine Institute in Istanbul', *Dumbarton Oaks Papers* 17 (1963), 333–72, esp. 335.
49 Ibid., 349.
50 Ibid.
51 Ibid., 351.
52 Brill (n. 33), 213.
53 Megaw (n. 48), 359.
54 Ibid., 362.
55 Theophilus, *De Diversis Artibus* 2:12: C.R. Dodwell, *Theophilus: the Various Arts*, London, 1961, 44.
56 Brill (n. 33), 215.
57 Ibid., 217.
58 F. Dell'Acqua, 'The stained glass windows from the Chora and Pantokrator monasteries: a Byzantine mystery?', in H.A. Klein (ed.), *Restoring Byzantium: the Kariye Camii in Istanbul and the Byzantine Institute Restoration*, New York, 2004, 68–77, esp. 68.
59 Megaw (n. 48), 365.
60 Ibid., 366.
61 Dell'Acqua (n. 58), 68.
62 Megaw (n. 48), 365.
63 J. Philippe, *Reflections on Byzantine Glass* (First International Anatolian Glass Symposium), Istanbul, 1988.
64 Megaw (n. 48), 365.
65 Ibid., 363.
66 Brill (n. 33), 215.
67 Dell'Acqua (n. 58), 33.
68 Ibid.
69 Megaw (n. 48), 364; G. Bovini, *Corpus della scultura paleocristiana, bizantina ed altomedioevale di Ravenna*, Rome, 1968.
70 Dell'Acqua 2005 (n. 6), 206.
71 Dell'Acqua 2005 (n. 6), 206; M. Mundell Mango and J. Henderson, 'Glass at Medieval Constantinople: preliminary scientific evidence', in C. Mango and G. Dagron (eds), *Constantinople and its Hinterland: Papers from the Twenty-seventh Spring Symposium of Byzantine Studies, Oxford, April 1993*, Aldershot, 1995, 333–58.
72 Brill (n. 33).
73 Mundell Mango and Henderson (n. 71), 353.

74 Brill (n. 33), 221.
75 Dell'Acqua (n. 58), 69.
76 Dell'Acqua 2005 (n. 6), 210.
77 Ibid.
78 S. Ćurčić, *Gračanica*, London, 1979, 61.
79 R. Ousterhout, *Master Builders of Byzantium*, Princeton, 1999, 153.
80 Ibid.
81 Dell'Acqua 2005 (n. 6), 196.
82 Megaw (n. 48), 349.
83 Dell'Acqua (n. 58), 74.
84 Megaw (n. 48), 357.
85 Dell'Acqua 2005 (n. 6), 196.
86 Nesbitt (n. 2).
87 Talbot (n. 17), 144.
88 John Aktouarios, *De spiritu animali 1.7.8 Physici et medici graeci minores* (I.L. Ideler [ed.]), Berlin, 1841 (repr. Amsterdam, 1963).
89 Dell'Acqua 2005 (n. 6).
90 Ibid., 195.
91 Ibid.
92 Nesbitt (n. 2).

Chapter 20
New Light on the 'Bright Ages'
Experiments with Mosaics and Light in Medieval Rome

Claudia Bolgia

It has long been recognized that the Middle Ages, far from being dark, were rich, imaginative and brightly colourful. Indeed, to some extent, the appellation 'Dark Age' remains associated with the 7th century, a period still often characterized as 'dark', even by specialists, not *per se* but because of the presumed paucity of both surviving monuments and written sources. However, this particular 'darkness' is rather the consequence of a scarcity of research than of actual low-quality artistic production. In the specific case of Rome and its architecture, the new light cast by Robert Coates-Stephens amply demonstrates the richness of building activity in the city in its supposed 'Dark Age'.[1]

As for the artistic production of the Middle Ages, advanced technical analyses undertaken over the last 30 years have revealed the extraordinary extent to which sculptures, micro-architectures and even entire buildings were covered with shining – often even flashy – colours. A *Medioevo colorato* thus emerges from the darkness with sparkling vitality.[2] In the case of Rome, this reappraisal means that we need to 'visualize' as fully coloured all the works that were later transformed into colourless and lifeless ghosts as a consequence of a change in taste: from the Early Christian sarcophagi to the more elaborate tomb monuments of the late 13th century. Indeed, some of these still retain visible vestiges of their vanished past: the gilded wings of the angels drawing the curtain of the tomb of Cardinal Matteo d'Acquasparta (d. 1302) at Santa Maria in Aracoeli constitute only one example among a myriad of cases.[3] Indeed, if one were to think of the best expression to characterize the Middle Ages, the most appropriate that comes to mind is 'Bright Ages'.

Mosaics differ from the above-mentioned examples because their polychromy is not applied, but structural, and hence inherent to their constituent material, that is glass and (more rarely in Rome) stone. Structural polychromy had the advantage of being longer lasting – potentially ever-lasting – and engaging more intensely with light. Clearly, this was especially true in the case of glass mosaics, given the special power of glass to encapsulate as well as reflect light. On account of their incorruptible – virtually eternal – and light-reflecting nature, mosaics, like gold and jewels, became metaphors of eternity, charged with the power to lead the mind away from the material world to the immaterial realm.[4]

It is thus unsurprising that mosaics were used primarily for apses and apsidal and triumphal arches, while wall painting was preferred for the nave and transept. If narrative scenes of the Old and New Testament (common on the clerestory walls of the naves) as well as lives and martyrdoms of saints (often found in transepts) could be rendered in a medium which might alter or fade away, the eschatological message or the very epiphany of the Divine (traditionally reserved to the apse and arch) deserved to be figured in an 'eternal' material, 'to last across centuries', as wished for in the inscription running under the apse mosaic of Santa Maria in Domnica in Rome.[5] It seems likely that the same principle applied to church exteriors, often decorated with mosaics on the upper part of the façade and wall paintings on the lower portion, especially when the latter was protected by a narthex, porch or atrium.[6] Of course, this choice was primarily motivated by practical

reasons (mosaics being more resistant to weather damage than painting), but the transition and visual 'ascension' from the earthly to the heavenly realm would have been most powerfully conveyed through such a change in medium.

It is my purpose here to discuss the new and experimental means by which glass tesserae were used in medieval Rome. The ultimate focus of my analysis will be to introduce the special way in which Cosmati artists exploited the expressive properties of the mosaic medium in order to convey metaphysical ideas. As is well known, 'Cosmati' is an umbrella term for at least seven different family workshops, their work being frequently and regrettably neglected in studies of the meaning and aesthetics of medieval mosaics.[7] The main reason for this general exclusion is the fact that the Cosmati are seen – and pigeon holed – mainly as *marmorarii* (marble workers), rather than mosaicists. It is unquestionable that what renders their art most distinctive and attractive is their ability to combine carving and mosaic inlay, associated with their knowledge of ancient sculpture, which expresses itself in the various forms of physical appropriation, imitation or creative inspiration. But discussion of Cosmati artworks traditionally focuses on the carving, to which the mosaic inlay is usually seen as ancillary. Even when studies deal with the geometric design of the inlay, the focus is not on the glass deployed in church furnishing but on the marble found in the mesmerizing carpet-like patterns of church pavements, and the primary intention seems to be to list and classify all the patterns in order to identify workshops, rather than to reflect upon the ability of the Cosmati to handle their materials.[8]

To contextualize my analysis, I shall devote the first part of my article to an altogether broader – albeit brief – discussion of mosaics and light in medieval Rome, a subject which has been largely overlooked by scholars.[9] My general argument is that for a full understanding of the subject it is necessary to combine different approaches, from the archaeological and technical, to the historical (considering both the context in which the work was commissioned and produced, and the later documentary evidence for alterations and changes), from the exegetical to the philological (paying special attention to the inscriptions that accompanied the artworks), to issues of perception and reception. Clearly, this is a wide subject, to which I will return with a broader project. Here, I shall simply address some of these issues through specific examples.

In her article on the apse mosaics of Santa Maria in Trastevere (1140–43), Dale Kinney commented on today's experience of seeing those mosaics:

> Even at noon it is dull, nearly colorless except for the gold, which glimmers fitfully, creating a textured atmosphere around the figures. Its visual quiescence is disrupted when a tourist drops some coins into a light box, and suddenly the apse explodes in color: turquoise, cobalt, sapphire, green, red, white, and gleaming gold. Excited eyes race over the newly patterned surface, trying to take it all in. With a click the purchased time elapses, the apse falls dark again, and the eye's delight is over. The visual experience was thrilling, and completely anachronistic. No one before the twentieth century could have seen the apse in the brilliant totality of electric light.[10]

It is vital to bear in mind that the medieval viewer was simply used to a different way of perceiving light. His eye had never experienced the results of electricity, let alone those of neon gas in advertising signs or digital images via computer screens. For eyes used primarily to natural light – oil lamps and candle flame being the only forms of 'artificial' light – the reflecting and refracting effect of the mosaic surface must have had a much more powerful, even intoxicating, effect.[11] The difference between our perception and theirs must have been abysmal: accustomed to a more subdued type of illumination, the medieval eye would have been unable to cope with today's artificial light. Conversely, our eye has been 'spoiled' by electric light. In order to view the mosaics with a 'medieval eye', it is crucial to remember that the medieval eye was simply used to a darker dimension. As for the perception of mosaics within churches, we need to remind ourselves continuously of the flickering effect created by the reflection and refraction of lamp and candle light on the mosaic tesserae, and of how this effect would have been enhanced when incense was scattered in the church, all senses being involved in the full experience of the sacred.

Within such a context, the medieval faithful too would have been able to experience something comparable to today's feast of the eye when the electric light is switched on. Such a ravishing attack on the senses would have taken place on special feast days, when churches were extraordinarily illuminated. One can only imagine the appearance of the apse mosaic of Old St Peter's at Easter, Christmas and on the feast day of Sts Peter and Paul, when the 1365 lights of its major cross-shaped chandelier (*farum*), hung before the sanctuary, were burning.[12] Notably, these were also to be lit on the anniversary of the donor pope, Hadrian I (AD 772–95), reminding the faithful of the light-bringing activity of this remarkable champion of Rome's renewal. And, of course, this was the major (*maior*), but not by all means the only, lighting device within the church, punctuated by innumerable candlesticks, lamps and chandeliers of different shapes and sizes.[13]

The image of St Peter's illuminated by so numerous sources of light brings to mind the words of Bishop Arculf on his visit from Gaul to Jerusalem in AD 670. After having stated that there were eight glazed windows in the western part of the round church of the Ascension, and that each window had a lamp hanging directly in front of it, he continued: 'on the night of the Feast of the Lord's Ascension, it is customary to add innumerable other lamps to the usual above-mentioned light of eight lamps which shine inside [the church] at night: under their awe-inspiring and wondrous gleaming light, streaming out copiously through the glass panes of the windows, the whole Mount Olivet seems not only to be lit up but even to be on fire'.[14]

Albeit rooted in the ekphrastic tradition, these comments remind us that any discussion of church illumination should include the windows. These have usually undergone several alterations across the centuries as part of various remodelling campaigns in post-medieval times. Thus, for a better understanding of how natural light engaged with mosaics, archaeological analysis ought always to be combined with later erudite accounts of the history of the

Plate 1 Window *transenna*, left transept, Santa Prassede, Rome, *c.* AD 817–19

building, as well as documentary evidence of the actual interventions, whenever these are available.

The church of Santa Prassede, built by Paschal I between AD 817–19, is a case in point. Most of the original openings are now blocked, but it has been established that the Paschalian basilica had 38 windows: 3 in the facade, 24 in the nave (12 per clerestory wall), 12 in the transept (6 per each arm of the transverse nave) and 5 in the apse, beneath the conch decorated with mosaics.[15] The windows were fitted out with thick stucco transennae, one of which still survives in excellent condition in the left transept, protected by the construction of the Romanesque bell tower (**Pl. 1**). The tiny triangular and arched openings of these screens were filled in with transparent yellowish and crystalline slabs of *selenite spatica* (sulphate of hydrated calcium),[16] which presumably filtered the light giving it an iridescent and warmer effect. Thus, during day time a 'warmed' iridescent sunlight poured in, engaging with the mosaics; during night time the lamp and candle light engaging with the mosaics must have also poured out, making the whole church radiate in the darkness, with an effect perhaps comparable to that of the church at the Mount of Olives.

It is unknown whether the transennae of Santa Prassede were originally painted over, but there is little doubt that the insertion of *selenite spatica* in its tiny openings created a jewel-like effect. In combination with the fictive (made of mosaic) cabochons and pearls bordering the church walls in both the apse and the transept, they must have contributed to transform the entire building into a heavenly Jerusalem, as described in the Book of Revelation: 'It [the holy city of Jerusalem] shone with the glory of God. It had the radiance of some priceless jewel, like a jasper, clear as crystal. The wall was built of jasper, while the city itself was of pure gold, bright as clear glass. The foundations of the city wall were adorned with jewels of every kind… the streets of the city were of pure gold, like translucent glass' (Rev. 21:10).

One would like to know the appearance of the lost transenna in the window of the contemporary chapel of St Zeno in Santa Prassede and whether *selenite spatica* was deployed there too. That window was the only source of illumination of a chapel entirely clad with mosaics, apart from the lower part of the walls, sheathed with marble.[17] On either side of the opening is Mary and St John the Baptist creating a sort of Deesis *ante litteram*, where the central Christ is substituted by the real light entering through the window. This opening, significantly located above the altar (and above a Transfiguration scene), was thus particularly important, and so also must have been its screen filtering the external light and 'turning' it into divine light.[18]

Selenite spatica may also have played a significant role in the crypt of this and other 9th-century churches of Rome. In the ceilings of the crypts of Santa Prassede (*c.* AD 817–19) and San Marco (*c.* AD 829–31), for instance, stucco is deployed in a manner which resembles the way gold was used in Lombardic or Visigothic jewellery or 9th-century cloisonné enamels: it creates cavities or cells of geometrical shapes (**Pl. 2**). Since the cavities are deep, it is possible that they were originally filled in with some malleable molten glassy substance, such as selenite, making the crypt look as if it were encrusted with priceless gems. In the absence of technical analysis, this remains a matter of conjecture for the moment. In any event, the use of selenite for both the stucco of the transennae (in the form of *scagliola*)[19] and the tiny transparent slabs in their interstices (in the form of *selenite spatica*) has been identified in the churches of Santa Sabina, Santa Prassede, and San Giorgio al Velabro, which were either newly built or restored in the late 8th and the first half of the 9th century.[20]

If the *metallum gypsinum* mentioned in the life of Leo III (AD 795–816) – 'fenestras… ex metallo gypsino decoravit' – can be identified with selenite,[21] then we would have identified another 'lens' through which to look at a crucial issue in the study of medieval art: its overt materiality as a means of leading to the immaterial world.[22] More specifically, we would have identified overlooked products of 8th- and 9th-century craftsmanship which require to be brought into the lively current debates on both the perception of the mosaics and the artists' ability to handle their medium in order to express metaphysical ideas, primarily that of divine illumination.

Plate 2 Detail of stucco ceiling in the crypt, San Marco, Rome, *c.* AD 829–31

Plate 3 Christ in a mandorla of light, detail of mosaic on the apsidal arch, Santa Maria in Domnica, Rome, *c.* AD 818–19

There can be little doubt that the medium which best served this purpose in Rome, at least from the 5th to the 14th century, was mosaic. Roman mosaics (as well as Byzantine ones) were completed by *tituli*, that is dedicatory inscriptions usually in leonine hexameters, in gold tesserae against a blue background, which often praised both the donor pope and the shining and glittering effects of the material deployed in the decoration of the church. The favour accorded to this colour scheme, adopted without exception for all mosaic inscriptions in Rome, from the earliest surviving example on the counter-façade of Santa Sabina (where the donor is the priest Peter the Illyrian, AD 422–32) to those commissioned by Nicholas IV (1288–92) at the Lateran and Santa Maria Maggiore, is probably to be explained by the fact that it expressed visually the triumph of light over darkness, a recurrent theme in the actual text of the inscriptions. Since the donors (usually the popes) were often presented in the *tituli* as those who brought the light to a building through its very reconstruction, it is not surprising that they wished to associate their names with this colour scheme.[23] Clearly, with light acting as a metaphor for Christ, the pope was presenting himself as an intercessor between the faithful and the divine illumination. The very preciousness of gold and blue, as well as the visibility afforded by the strong colour contrast must have further contributed to the success of the gold-and-blue combination. It is worth noticing that similar mosaic inscriptions in gold tesserae set amidst a blue ground, written in the name of the ruling caliphs, are also attested in the Islamic world, under both the Abbasids and the Umayyads.[24] The source of inspiration was presumably to be found in Byzantium and Rome.

Even if the verses in the Roman *tituli* depended on some rhetorical conventions, there can be little doubt that both the popes who commissioned the mosaics and the learned scholars who conceived the wording of the inscriptions intentionally associated the material with light symbolism, and were fully aware of the expressive power of the mosaics as the perfect vehicle by which the metaphysical idea of divine illumination might be transmitted. The artists, in their turn, skillfully handled their medium to enhance the glitter by means of special technical devices.[25] The *titulus* accompanying the mosaics of Santa Maria in Domnica (*c.* AD 818–19) in Rome, commissioned by Paschal I, the very same patron of Santa Prassede, is remarkable for making an explicit parallel between the decoration of the church and divine light.[26] The text reads as follows:

ISTA DOMVS PRIDEM FVERAT CONFRACTA RVINIS / NVNC RVTILAT IVGITER VARIIS DECORATA METALLIS / ET DECUS ECCE SVVS SPLENDET CEV PHOEBVS IN ORBE / QVI POST FVRVA FVGANS TETRAE VELAMINA NOCTIS / VIRGO MARIA TIBI PASCHALIS PRAESVL HONESTUS / CONDIDIT HANC AVLAM LAETVS PER SAECLA MANENDAM

The translation of such sophisticated texts as the *tituli*, imbued with literary references and rich in multiple allusions, is always difficult. In the case of this particular one, the difficulty is increased by the presence of an apparent puzzling error. While the inscription is metrically correct, *qui post furva fugans* is meaningless. It seems probable that the adverb *post* (after) replaced an original verb in the third person, such as *stat* ('is present', 'is the reference point of the universe').[27] For reasons of clarity, I offer a translation (where the word *post* has been amended with *stat*), followed by some observations about additional layers of meaning:

> This edifice had once fallen into ruin. Now it shines endlessly, decorated with multicoloured materials, and its beauty radiates like the sun over the world, [the sun] whose very existence (presence) dispels the dark veil of the gloomy night. Virgin Mary, it is for you that the honourable pontiff Paschal has built this hall with joy, to last across the centuries.[28]

Since, among other things, the word *metallon* in Greek means marble quarry and was also used to indicate precious stones, *metalla* (plural of the Latin *metallum*) is usually translated as 'glittering tesserae' (mosaics combining marble and glass cubes).[29] Nevertheless, it should be noted that since antiquity, the term *metallum* is often found accompanied by a word indicating a specific material: to the above-mentioned *metallum gypsinum* (stucco), one could add the *metallum ligneum* (wood), the *metallum corallum* (coral), the *metallum porphyriticum* (porphyry), and the *pretiosa marmorum metalla* (precious marble).[30] In other words, the very term *metallum* (at least from antiquity to the 9th century) seems to have meant 'material' (both found naturally and produced by men), and it would appear that a specification was required whenever it was deemed necessary to explain what the material in question was. A passage in Martianus Capella is particularly eloquent, recording 'four small urns made of various species of metals, that is iron, silver, lead, and glass'.[31]

A specific word to designate mosaic did exist, as attested by the *Liber Pontificalis* where the mosaics commissioned by the popes are described with the very specific term *musivus* or *musibus*.[32] Thus, it seems probable that the verse inscription did not refer exclusively to the glittering tesserae of the mosaics but to all the various light-bearing and light-reflectant materials deployed by Paschal in the interior decoration of the church, which included a silver

canopy weighing 332lb, silver sheets for the altar's *propiciatorium* (presumably the frontal), a fine gold bowl, a silver arch on colonnettes for the front of the *confessio* and grills inside and outside weighing 115lb, 3oz.[33]

Returning to the *titulus*, the *decorum*/beautiful appearance of the church (*suus decus*) is said to shine like *Phoebus in orbe*. Phoebus was the Greek appellation of Apollo as a God of Light although, in medieval poetry and literature, the word became a synonym for the sun. Thus the interior of the church radiates like 'the sun over the world'. The use of the adverb *iugiter* (continuously, uninterruptedly, in perpetuity) in combination with the verb *rutilare* (to glow in the sense of bearing and reflecting a light with red hue connotations), the metaphor of the sun that with its light-issuing presence dispels the darkness of the dreary night, all convey the idea of the continuous flicker of the light on reflective surfaces.

More importantly, the *titulus* awards the materials decorating the church – chief amongst them the mosaics – with the power to shine and 'radiate' like the sun over the world, but also like the Divine Light (Christ being the 'Light of the World', John 8:12), acknowledging the power of the material to express the metaphysical idea of divine light.[34] The association with Christ in a mandorla of light at the very apex of the apsidal arch (and indeed seated on the globe or the semispherical orbit of the sun) is all too clear (**Pl. 3**).[35] It is worth noting that in an era of iconoclasm the parallel between material light and divine light is made visually through the very image of Christ in the mandorla, but verbally only through the mediation of Phoebus/sun.[36] In visually 'translating' *Phoebus in orbe* as Christ in an aureole of light, figural art in 9th-century Rome is allowed the freedom to 'say' something more daring than words. It has also never previously been noticed – as far as I am aware – that the unusual expression *Phoebus in orbe* is found in the almost contemporary, very 'visual' poem written by Ermoldus Nigellus in honour of Louis the Pious (AD 825–6). The relevant passage reads: '…resplendetque suis Phoebus in orbe comis'.[37] Both the *titulus* and the poem are clearly the products of the same 'Carolingian' cultural milieu, but we cannot exclude the possibility that Ermoldus knew the actual inscription at Santa Maria in Domnica and might even have been in Rome when the mosaics were being set on the walls. In other words, one cannot rule out that those very words echoed in his memory. Nor should we forget that Ermoldus took a keen interest in art, discussing at length – in the very same poem – the Old and New Testament cycles depicted on the walls of the Imperial Chapel at Ingelheim, as well as the 'deeds of the Fathers' in the palace there.[38] At Santa Maria in Domnica, the 'dark veil of the dreary night' is vanquished by the shining materials decorating the church, notably by the mosaics, both through their brightness and their ability to give visual form to the Phoebus-Christ.

It is commonly recognized that over the following centuries both inscriptions and manufacture point towards an increasingly reduced interest of patrons and artists in the expressive potential of mosaic glass. By the 12th and 13th centuries, artists appear to be less interested in the mosaic medium as a perfect vehicle to materialize divine light, whereas – in the wake of a new taste for realism – had become primarily concerned with painting as the medium which could best render the new interest in vivid human forms and their physical and habitable context.[39]

Plate 4 Front of the 'ara coeli' *confessio*, north transept, Santa Maria in Aracoeli, Rome, *c.* 1250s

Plate 5 The 'ara coeli' (*spolia* porphyry sarcophagus from the Hadrianic period), north transept, Santa Maria in Aracoeli, Rome

However, one work at least can be shown drastically to diverge from this pattern, revealing an extraordinarily innovative way of experimenting with glass mosaic, in order to express not only the idea of divine light (and illumination), but also notions of time and space, and even of change across time and space. In this work, the 'material' is used to express ideas which are traditionally visualized through 'form', that is, primarily through architectural or figural elements. The artefact in question is the front of the *confessio* (or pseudo-*confessio*, to be exact) of the so-called 'ara coeli' or altar of heaven in Santa Maria in Aracoeli, Rome. Its date is extremely difficult to establish, but there is sufficient evidence (both historical and iconographical) to suggest that it was made in the mid-13th century, most probably in the 1250s.[40]

The *confessio* is hard to access as it is partly sunken in the northern transept floor and partly surrounded by the steps of a modern baldachin chapel (1888) (**Pl. 4**). It must be noted that the altar or 'ara coeli' proper was – and still is – the porphyry sarcophagus (**Pl. 5**) and not the Cosmati piece, which formed the frontal of the *confessio*, originally just beneath the sarcophagus. Through the central *fenestella*, the faithful could approach the relics of St Helena and Sts Abondio and Abbondanzio, preserved in the sarcophagus above. The illustration constantly used for every discussion of the *confessio* is that of a 20th-century plaster cast, reproducing the whole front (**Pl. 6**), which is otherwise

Plate 6 Plaster cast of the front of the 'ara coeli' *confessio*, Museo della Civiltà Romana, Rome (inv. M.C.R nr. 555), *c.* 1930s

impossible to photograph. However, this cast by no means does justice to the quality of the original. Far from being rudimentary or 'childish', as it is so often described, the *confessio* is a highly accomplished work, the imagery of which is rich in sophisticated references, expressed by a combination of peculiar iconographic choices and innovative technical devices.

Throughout the Middle Ages, the 'ara coeli' was associated with the legend of the miraculous apparition of the Virgin and Child to the Emperor Octavian Augustus (43 BC–AD 14).[41] The earliest reference to a Christian altar on the hill is found in an eastern legend included in the *Chronicon* of John Malalas, ascribed to the second half of the 6th century. This records that Augustus built on the Capitoline Hill an altar dedicated to the Son of God, 'which is still visible, as reported by the *Timotheus*', a now-lost Byzantine Chronograph datable to the end of the 5th or beginning of the 6th century.[42] And so it seems that by this time a Christian altar stood on the Capitoline hill. The first certain mention of a Marian church on the hill is a passage in the 8th-century Latin version of the *Chronicon* of Malalas, where the anonymous author adds that, in the place where Emperor Augustus had installed an altar in honour of the Son of God, a church dedicated to 'beatae et semper virginis Mariae' was erected some years later ('post tot annis'), and was still standing there at the time of writing.[43] Although the expression 'post tot annis' is a conventional *topos*, there is no reason to doubt the actual early existence of the church.

The most widely known version of the legend is that of the 12th-century *Mirabilia Urbis Romae* according to which the senators, having seen the peace and prosperity with which the whole world lay subject to the emperor, told him that they wanted to worship him because they thought that there was divinity in him.[44] Augustus opposed the idea and asked for the opinion of a prophetess, the Tiburtine Sybil. She went to his palace and told the emperor that a king would come from the heavens (*e caelo*); and then, on the spot, the sky/heavens opened (*apertum est caelum*) and a dazzling light shone upon him (*et nimius splendour irruit super eum*); and he saw in the sky/heavens (*in caelo*) a most beautiful Virgin standing over an altar, holding a child in her arms. The emperor was filled with wonder and heard a voice saying: 'This is the altar [*ara*] of the Son of God'. The emperor immediately fell upon the ground in adoration. This vision – the *Mirabilia* continues – occurred in the chamber of Emperor Octavian where now is the church of Santa Maria in Capitolio. That is why it is called 'Sancta Maria Ara Caeli' (the Latin word *coelum/caelum* meaning both sky and the heavens).

The story is further elaborated in the *Legenda Aurea* (*c.* 1260–7), where – amongst various differences – it is said that at high noon a golden circle appeared around the sun and in the centre of it there was a Virgin of wondrous beauty, holding a child in her bosom.[45] The detail of the golden circle has been used to argue that the front of the *confessio*, where the Virgin and Child appear in a mandorla of light, must be dated after the 1260s.[46] However, it should be noted that by the 1240s the Dominican compiler Bartholomaeus Tudertinus had already included a *circulus aureus* in his account of the vision, part of his Christmas *Epilogus*.[47] Although he did not specify his source, the idea of the circle of light derives from Orosius – in his turn borrowing from Suetonius – who stated that at the time of Octavian 'suddenly in a pure, clear and serene sky a circle similar to a celestial orbit surrounded the sphere of the sun' to signify that Octavian's splendour was to be overshadowed by a brighter light.[48] It is probable that Bartholomaeus borrowed from Orosius, whose work was widely known in the Middle Ages, and it would not be unreasonable to suggest that whoever acted as an advisor for the conception of the *confessio* (presumably an Aracoeli friar) was aware of Bartholomaeus' *Epilogus* or of a contemporary Franciscan source, or indeed of a 'local' Aracoeli source, which already contained a reference to a circle of light.[49]

The church that we see today, standing prominently on top of the *Arx* or northern summit of the Capitoline Hill, was built by the Franciscans some decades after they took over the site from the Benedictines in the mid-13th century.[50] The edifice which they found on the site occupied the area of the present transept: more precisely, the nave of the earlier church stood where the present transept stands, and the 'ara coeli' – the porphyry sarcophagus – was the high altar of that church.[51]

The foundation legend of Aracoeli is part of the imagery of the *confessio* (**Pl. 6**), and constitutes the narrative preamble for the setting-up of the 'ara coeli', that is the porphyry altar above.

As with many apse mosaics in Rome, we are fortunate in that the inscription on the *confessio* survives. The text reads 'LVMINIS HANC ALMAM MATRIS QVI SCANDIS AD AVLAM CVNCTARVM PRIMA QVE FVIT ORBE SITA / NOSCAS QVOD CESAR TVNC STRVXIT OCTAVIANVS HANC ARA CELI SACRA PROLES CVM PATET EI', which may be translated as 'You, who ascend to the holy church of the Mother of Light, the first of all (those) founded in the world, know that Caesar Octavian built this altar of heaven (*ara celi*) when the holy offspring was revealed to him'.

While claiming that the church where the altar stands is the first ever built in the world (*cunctarum prima quae fuit orbe sita*), the inscription calls Mary the Mother of Light (*Mater Luminis*), an uncommon, but not unprecedented, expression

Plate 7 Capital with fauns' protomes and oak leaves, front of the 'ara coeli' *confessio*, Santa Maria in Aracoeli, Rome, *c.* 1250s

Plate 8 Emperor Augustus, front of the 'ara coeli' *confessio*, Santa Maria in Aracoeli, Rome, *c.* 1250s

in Marian literature, occurring – for instance – in a 9th-century Latin translation of a *Laus* to the Virgin by Germanus of Constantinople, and in the *Libellus Epistolaris* on the Virginity of the Blessed Mary by Hugh of St Victoire.[52]

As opposed to the Early Christian and early medieval mosaic *tituli*, such as that at Santa Maria in Domnica, nowhere in the text, however, is the medium of mosaic explicitly mentioned as being capable of conveying the idea of divine light. Despite the silence of the inscription, the actual expressive possibilities of the glass are skilfully deployed in the service of such an idea, and are taken even beyond it.

To understand the extent to which the mosaic not only complemented the iconography, but indeed enhanced and enriched its message, my analysis is necessarily concerned with both sculpture and mosaics. I shall begin with the former. The central *fenestella* is framed by an arch borne on twisted colonnettes with foliated capitals decorated with fauns' protomes, oak leaves, and acorns (**Pl. 7**). These may be simple quotations *all'antica*: yet their choice is very appropriate both to the site and to the legend depicted in the spandrels above. Significantly, in the *Aeneid*, King Evander – the founder of the citadel on which Rome would be later founded – states that the woods of Latium were originally inhabited by the fauns, wild creatures born out of an oak (*Aeneid* VIII, 314–18). Given the fortune enjoyed by the *Aeneid* in the Middle Ages,[53] it is possible that this passage echoed in the mind of whoever conceived the programme of the *confessio*, alongside with the belief that the fauns were oracular creatures, associated with visions.[54] If this were the case, the capitals with distinctive oak leaves, fauns' protomes and acorns were meant to make reference to the 'pre-history' of the site and – with their prophetical and oracular connotations – to create a bridge between the pre-Christian time and the Christian age.

The capitals with pagan symbols literally support an arch bearing an intense, abridged, version of the legend of the establishment of the Christian cult on the hill, thus creating a powerful visual association between the pagan past and the Christian present (**Pl. 6**). On the left spandrel (**Pl. 8**) Augustus is portrayed at the most dynamic moment of the dazzling revelation, when he bends his knees in adoration, having suddenly realized that the new king-to-be has appeared in a circle of light before his very eyes. On the other spandrel the vision proper materializes, deeply carved in the thickness of the marble (**Pl. 9**): in a mandorla of sunrays, the Child is displayed in the arms of his Mother.

The iconography of the Virgin and Child is strikingly novel in its combination of details (**Pl. 10**). Mary is standing, her head framed by the jagged outline of the *maphorion*; she wears an outer garment that falls diagonally over her legs, a type of vestment similar to that of Maria Regina formerly in the oratory of John VII (AD 705–7) in Old St Peter's. The novelty here is that the folds literally turn into vibrant sunrays, merging with the rays surrounding the vision. The representation of the Virgin as the very source of light matches her appellation as *Mater Luminis* in the verse inscription on the *confessio*. Simultaneously, the unique folds of Mary's outer garment, turning into the radiating sunrays of the vision, literally clothe the Virgin 'with the sun', thus creating an association with the 'woman clothed with the Sun' as described in Revelation 12:1–18.[55] Significantly, the Apocalyptic woman 'brought forth a Man Child, who was to

Plate 9 Detail of Virgin and Child, front of the 'ara coeli' *confessio*, Santa Maria in Aracoeli, Rome, *c.* 1250s

Plate 10 Virgin and Child, front of the 'ara coeli' *confessio*, Santa Maria in Aracoeli, Rome, *c.* 1250s

Plate 11 Agnus Dei bleeding into a chalice, front of the 'ara coeli' *confessio*, Santa Maria in Aracoeli, Rome, *c.* 1250s

rule all nations': there would be no better words to describe the very grown-up Child in the Aracoeli relief.

The cross in the nimbus of the Child-Man foretells Christ's death and his sacrifice for humanity. It links the Child visually to the cross-haloed *Agnus Dei* which features prominently in the medallion just above the *fenestella* (**Pl. 11**). Bearing a crossed emblem while bleeding into a chalice, the Lamb of God symbolizes the incarnation of Christ, his flesh and blood, and his subsequent death by means of the Cross. The use of drill dots to articulate the Child's garment finds an echo in the similar articulation of the fleece of the Lamb. A technical device is therefore employed to reinforce the conceptual association already created by an iconographical detail (the crossed-halo): the Child of the vision is the sacrificial Lamb of God.

It is worth noting that our appreciation of this work is limited by the loss of its original polychromy, traces of which can be barely seen in Christ's halo (gold), the Virgin's garment (blue), and much more clearly in the medallion encasing the Lamb, where most of the drill dots are filled in with blue glass (**Pl. 11**). Thus the 'staccato' effect of the reliefs, resulting from their white surface, is not original, and our understanding of the work should not be affected by it.[56]

The representation of the legend of Augustus serves as a visual reminder of the event that led to the setting-up of the *ara*: according to the legend, it was immediately after experiencing the luminous vision that Augustus set an altar on the hill in honour of the Son of God. Hence, we are led from the pagan past (the acorns, oak leaves and fauns), to the moment of the annunciation of a new era (Augustus and the infant King), to the incarnation and sacrifice of Christ (the Mother and cross-haloed Child, the bleeding Lamb), to the actual erection of the 'first' Christian altar for the liturgical re-enactment of Christ's sacrifice (the porphyry trough).

Thus, the iconographic programme of the *confessio* focuses on the Eucharistic doctrine, on Christ's birth and death, on his incarnation and sacrifice for the remission of the sins of the faithful, and – at the same time – on the ancient origins of the site, on its past greatness and significance. It is a most appropriate programme with which to complete a *spolia* porphyry trough that had to embody the claim to be the altar of the earliest church ever set in the world.

What role then does the mosaic play within this programme? Let us turn to the analysis of the glass inlay. On the left spandrel, behind and below Augustus (in the space and time preceding the dazzling vision) the background (**Pl. 8**) is composed of a distinctive lozenge pattern obtained by using red and dark blue *listelli* or *bastoncini* (elongated rectangular *tesserae*) and by filling the areas between the *listelli* with red or blue glass cubes disposed as rhomboids and framed by four white triangular tesserae. The general effect is that of an interwoven diapered textile. Before Augustus, in the right part of the very same spandrel – above his outstretched hands (that is in the time and space of the marvellous revelation) – the same interwoven pattern is inclined at a different angle, becoming more horizontal, and is enriched by the use of shining gold cubes. It is as if the light issuing from the vision shone down upon Augustus (*et nimius splendour irruit super eum*, in the words of the *Mirabilia*), simultaneously connecting him with the Mother and Son on the other spandrel. There, the background pattern changes again, turning into a celestial motif with golden dots, which evokes the sky/heaven as the 'place' where the apparition occurs (**Pl. 10**). The transition effect is enhanced by the fact that the surface of the spandrel behind Augustus is concave (**Pl. 8**), whilst that behind the miraculous vision is flat (**Pl. 10**).

A combination of material (the use of gold), surfaces (curve and flat), setting of the tesserae (with different inclinations) and changing patterns of mosaic inlay contribute to express the idea of the Virgin as the Mother of Light and of Augustus as the recipient of divine illumination. There is much more: through these sophisticated artistic devices, the artist also renders the notions of time and space, and indeed the notion of change across time and space, without using any formal (architectural or figural) elements. On the left hand-side is the pre-Christian past – a time and a space that was not illuminated by the light of the faith (a time of darkness, where no gold is employed); in the centre is the crucial moment of the revelation, the beginning of a new era illuminated by the Light of Christ (and permeated by the presence of gold); on the right hand-side, the celestial materialisation of the Mother of Light, simultaneously announcing the first and second coming of Christ.

The choice of patterns is extremely interesting: the lozenge pattern *a listelli* is very rare amongst Cosmati motifs. The choice seems deliberate. The pattern evokes a fabric, a woven textile or curtain, and it is significant that the most cogent visual parallel which I am able to suggest is the diapered pattern of the curtain or veil of the Jewish Tabernacle as depicted in medieval art, especially in manuscript illuminations, such as the miniature in *Christian Topography* at the Vatican Library.[57]

In the Old Testament the curtain of the tabernacle (later of the Temple), which separated the Holy from the Holy of Holies, was accessible only to the High Priest, and then only once a year.[58] In the New Testament, the curtain is said to have been 'torn in two, from top to bottom' (Matthew 27:51, and Mark 15:38) at the moment that Christ died on the Cross, thereby making the Jewish sanctuary accessible to all. In his Epistle to the Hebrews, St Paul argued that 'Christ's

flesh is the veil', and in the Second Letter to Corinthians he stated that the veil that prevented mortals from seeing salvation had been done away – torn apart – by the sacrifice of Christ.[59] Thus, Christ's incarnation and sacrifice by means of the Cross unveiled the hidden mysteries of the Old Testament, tearing apart the obscuring veil, and rendering the sacred accessible to mankind. Erik Thunø has appropriately drawn a connection between the dispelling of the *furva velamina tetrae noctis* of the inscription at Santa Maria in Domnica and the veil of the tabernacle.[60]

At Santa Maria in Aracoeli, the mosaic pattern on the left hand-side of the *confessio* renders in visual form the veil that prevented mortals from seeing salvation. This is torn apart in the very centre of the composition when the light penetrates it, passing through its weaving. Interestingly, the diapered pattern here not only incorporates golden cubes (the light replacing darkness), but also becomes more horizontal, visually connecting the kneeling emperor to the vision. This change in inclination conveys a sense of hope: in an era illuminated by the Christian faith, people can 'see' salvation.

The intelligent use of the medium renders the composition fluid and dynamic, expressing the notion of continuity (with the pre-Christian past – the era of obscurity) and change (the start of the new Christian era – the era of light) in quite extraordinary visual terms. The concept of change is further emphasized by the transformation of the carved foliage surrounding the colonnettes and the under-arch. The elongated acanthus leaves on the left hand-side are transformed into curly leaves within a vine scroll on the right hand-side (**Pl. 6**). Simultaneously, inasmuch as the curtain is 'the flesh', it is also a sign of the Eucharistic body of Christ. Thus, its visual representation through the mosaic pattern perfectly complements the figural rendering of the same concept through the carved Lamb of God above the *fenestella*, the actual physical threshold between the space of the faithful and the sacred space beyond.

In conclusion, the iconographic programme of the *confessio* creates a bridge between pagan past and Christian present, centring on the incarnation of Christ, on his flesh and blood and on his sacrifice for humanity. The medium of glass is used in an experimental way, to add further layers of meaning to the figural programme, evoking – through its pattern – the curtain of the Temple, and expressing – through the insertion of gold within that pattern – the Christian metaphor of the vanquishing of the veil, which allowed light to replace darkness. The reference is to the incarnation and sacrifice of Christ, who has come to liberate mankind from the darkness of mortality. The Cosmati artist responsible for this work handled his medium in a highly original manner, integrating the expressive power of figural sculpture with the wise deployment of glass tesserae, not only to materialize the idea of divine illumination, but also to capture in virtual action the crucial moments of Christian history, namely the transitions from the age of darkness to the age illuminated by the Christian faith, to the final era of eternal light.

Notes

1 R. Coates-Stephens, 'Dark-Age architecture in Rome', *Papers of the British School at Rome* 65 (1997), 177–232.

2 The literature is very extensive: see notably, *Il Colore nel Medioevo: Arte, simbolo e tecnica, Atti delle Giornate di Studio* held at Lucca on 5–6 May 1995, 2–4 May 1996, and 23–6 September 1999 (the latter specifically dedicated to window glass: *La vetrata in Occidente dal IV all'XI secolo*), and published at Lucca in 1996, 1998 and 2001, respectively, as nos 1–3 of the *Series Collana di Studi sul Colore*. The fourth volume of the series is specifically devoted to stone: *Pietra e Colore: Conoscenza, Conservazione e Restauro della Policromia, Atti delle giornate di studio, Lucca 22–4 November 2007*, Lucca, 2009. These volumes include updated and comprehensive bibliographies.

3 On the d'Acquasparta sepulchral monument see R. Carloni, 'Alcune osservazioni sulla tomba del cardinale Matteo d'Acquasparta in S. Maria in Aracoeli', in A.M. Romanini (ed.), *Roma anno 1300*, Atti della Quarta Settimana di Studi di Storia dell'Arte Medievale dell'Università di Roma "La Sapienza" (Rome 1980), Rome, 1983, 643–9.

4 The literature on this is vast; see notably H. Kessler, *Seeing Medieval Art*, Ontario, 2004, esp. 19–42, with relevant earlier bibliography.

5 The text of this inscription is discussed in detail below.

6 The most recent discovery of such wall decorations – a late 7th or early 8th-century mural on the façade of Santa Sabina, to the right of the main portal – is published in C. Tempesta (ed.), *L'icona murale di S. Sabina sull'Aventino*, Rome, 2010.

7 A famous exception is the case of the Cosmati work in Westminster Abbey, which – probably on account of its uniqueness in England – is both well known and well studied. Nonetheless, the discussion about Westminster has been – unsurprisingly – concerned with the marble inlay of the sanctuary floor, with a special focus on the aesthetical and ideological significance of its principal constituent: coloured *spolia* marble. See P. Binski, 'The Cosmati and *romanitas* in England: an overview', in L. Grant and R. Mortimer (eds), *Westminster Abbey. The Cosmati Pavements*, Aldershot, 2002, 116–34; P. Binski, 'The Cosmati at Westminster and the English court style', *Art Bulletin* 72 (1990), 6–34; for a prosopographical approach, see J. Gardner, 'The Cosmati at Westminster: some Anglo-Italian reflections', in J. Garms and A.M. Romanini, *Skulptur und Grabmal des Spätmittelalters in Rom und Italien: Akten des Kongresses 'Scultura e monumento sepolcrale del tardo Medioevo a Roma e in Italia'* (Rome, 4–6 July 1985), Vienna, 1990, 201–16.

8 The best study of Cosmati work is still P.C. Claussen, *Magistri Doctissimi Romani: Die römischen Marmorkünstler des Mittelalters. Corpus Cosmatorum I* (Forschungen zur Kunstgeschichte und christlichen Archäologie, 14), Stuttgart, 1987. See also P.C. Claussen, *Die Kirchen der Stadt Rom im Mittelalter 1050–1300*, Stuttgart, 2002, of which two volumes have appeared so far: volume I, covering churches in alphabetical order A-F (2002), and volume II, entirely devoted to the Lateran Basilica (2008) – both volumes with extensive and updated bibliography. On Cosmati pavements see D. Glass, *Studies on Cosmatesque Pavements*, Oxford, 1980. P. Pajares-Ayuela, *Cosmatesque Ornament: Flat Polychrome Geometric Patterns in Architecture*, London, 2002, is primarily a catalogue of the different patterns. For Cosmati furnishing outside Rome, the most recent work is M. Gianandrea, *La scena del sacro: l'arredo liturgico nel basso Lazio tra XI e XIV secolo*, Rome, 2006.

9 The main reference, is P. Hills, *The Light of Early Italian Painting*, London, 1987, 29–40 (Chapter 2: 'Cavallini and the mosaic tradition').

10 D. Kinney, 'The apse mosaic of S. Maria in Trastevere', in E. Sears and T.K. Thomas (eds), *Reading Medieval Images: The Art Historian and the Objects*, Ann Arbor MI, 2002, 19–26.

11 On the engagement of mosaics with light, see especially L. James, *Light and Colour in Byzantine Art*, Oxford, 1996, with relevant bibliography.

12 L. Duchesne (ed.), *Le Liber Pontificalis. Texte, introduction, commentaire*, 1, Paris, 1843, (henceforth *LP*), 97: 46: *'Denique eius beatitudo fecit et farum maiorem in eadem beati Petri ecclesia, in tipum crucis, qui pendet ante presbiterium, habentem candelas mille CCCLXV; et constituit ut quattuor vicibus in anno ipsum farum accendatur, id est in natale Domini, in Pascha, in natale Apostolorum et in natale pontificis'.*

13 One can appreciate this looking through the *Liber Pontificalis*: Constantine – to start with – is recorded to have donated, amongst many lamps, 'four brass candelabra, 10 ft in size, finished in silver with silver medallions of the acts of the Apostles, each weighing 300lb', specifically destined for the saint's tomb: *LP*, I, 34: 18. I plan to return to the vast issue of church illumination in Early Christian and medieval Rome more fully elsewhere.

14 Adamnanus, *De Locis Sanctis libri tres*, L. Bieler (ed.), in *Corpus Christianorum Series Latina*, vol. 175, Turnhout, 1965, 199–202 (book 1, ch. 23). It is debated whether Arculf is a real historical figure or a fictional construct of Adamnan's literary imagination: whatever the case, my argument remains unaffected. See Th. O'Loughlin, 'The exegetical purpose of Adomnán's *De Locis Sanctis*', *Cambridge Medieval Celtic Studies* 24 (1992), 37–53; D. Woods, 'Arculf's Luggage: The sources for Adomnán's *De Locis Sanctis*', *Ériu* 52 (2002), 25–52. I am grateful to Dr Heather Pulliam for these references. Concerning the hotly debated issue of rhetoric versus reality in medieval literary descriptions of artworks, it is worth bearing in mind that, while subscribing to literary conventions, these descriptions always reflected an actual form of perception: James (n. 11), 89–90 and 117–19. See also E. Borsook, 'Rhetoric or reality: Mosaics as expressions of a metaphysical idea', *Mitteilungen des Kunsthistorischen Institutes in Florenz* 44 (2000), 2–19. On the *topos* that palatial or religious interiors were so luminous that they shone 'with their own sun', see F. Barry, 'The house of the rising sun: luminosity and sacrality from domus to ecclesia', in A. Lidov (ed.), *Light and Fire in the Sacred Space, Materials from the International Symposium*, Moscow, 2011, 51–3. I thank Eve Borsook for this reference.

15 M. Caperna, *La Basilica di Santa Prassede. Il significato della vicenda architettonica*, Rome, 1999, 38. It is equally interesting to look at cases where the mosaics are set in a pre-existing building, such as Felix IV's SS. Cosma e Damiano. There, an apse had been added to the Severian basilica in the first half of the 4th century. It had two monumental windows, flanking on either side a central pair of small windows, and a tiny door. Under Felix IV the level of the pavement was raised, thus rendering the small door inaccessible, and the two large windows were turned into monumental doors, presumably for functional and liturgical reasons. In this case, however, the doors and windows did not filter any direct light as they opened onto a covered room behind the apse. For the architectural interventions at SS Cosma e Damiano see P.L. Tucci, 'Nuove acquisizioni sulla basilica dei Santi Cosma e Damiano', *Studi Romani* 49 (2001), 275–93.

16 A. Muñoz, 'Studi sulle basiliche romane di S. Sabina e di S. Prassede', *Dissertazioni della Pontificia Accademia Romana di Archeologia* 13 (1918), 117–31.

17 On this chapel, see B. Brenk, 'Zum Bildprogramm der Zenokapelle in Rom', *Archivo Español de Arqueología* 45–7 (1972–4), 213–21; M.W. Asmussen, 'The chapel of S. Zeno in S. Prassede in Rome: new aspects on the iconography', *Analecta Romana Instituti Danici* 15 (1986), 67–86; G.V. Mackie, 'The Zeno chapel: a prayer for salvation', *Papers of the British School at Rome* 57 (1989), 172–99; E. Thunø, *Image and Relic: Mediating the Sacred in Early Medieval Rome* (Analecta Romana Instituti Danici Supplementum, 32), Rome, 2002, 143–4; the most recent work on the patronage of Paschal I is C. Goodson, *The Rome of Pope Paschal I. Papal Power, Urban Renovation, Church Rebuilding and Relic Translation, 817–24*, Cambridge, 2010. None of these discusses the issue of the original fitting of the window, and its implications with regards to meaning and perception.

18 It is certainly not coincidental that the 13th-century mosaic in the niche just above the altar (beneath the window and the Transfiguration) shows an enthroned Mary holding a Christ-Light in her lap, as indicated not only by the brightness of his garment and halo, but also by the words on his scroll identifying him with the Light (= *Ego sum Lux*, John 8:12). On this image, presumably replacing a 9th-century one, see V. Pace, 'Cristo-Luce a Santa Prassede', in A. Amberger *et al.* (eds), *Per assiduum studium scientiae adipisci margaritam. Festgabe für Ursula Nilgen zum 65. Geburstag*, St. Ottilien, 1997, 185–200.

19 The so-called *scagliola* is an artificial substance made from selenite cooked at 100 degrees, then reduced to powder, mixed with water, and then poured into casts where it is left to solidify. Technical analyses undertaken by Muñoz has shown that the stucco is made of *scagliola* rather than marble powder: Muñoz (n. 16); A. Muñoz, 'Studi e restauri nelle chiese di Roma, S. Giorgio in Velabro, S. Prassede', *Capitolium* 3. 9 (December) (1927), 441–51.

20 Muñoz 1927 (n. 19).

21 *LP*, II: 98, 31. A. Muñoz, *Il restauro della basilica di S. Giorgio al Velabro in Roma*, Rome, 1926, 27.

22 On materiality in medieval art see Kessler (n. 4), 19–42, with relevant literature.

23 On early medieval inscriptions in Rome see also C. Belting-Ihm, 'Zum Verhältnis von Bildprogrammen und Tituli in der Apsisdekoration früher westlicher Kirchenbauten', in *Testo e Immagine nell'Alto Medioevo* (Atti delle Settimane di Studio del Centro Italiano di Studi sull'Alto Medioevo 41), 2 vols, Spoleto, 1994, vol. 2, 839–85. On the S. Sabina inscription see E. Thunø, 'Looking at letters: 'living writing' in S. Sabina in Rome', *Marburger Jahrbuch für Kunstwissenschaft* 34 (2007), 19–41. On Nicholas IV's inscriptions see A. Salvi, 'Nicolai PP. IV musiva inscriptio in Basilica Lateranensi', *Collectanea Franciscana* 60 (1990), 191–9, which focuses primarily on the content of the text.

24 A. George, 'Calligraphy, colour and light in the Blue Qur'an', *Journal of Qur'anic Studies* 11.1 (2009), 75–125.

25 Borsook (n. 14), 2–19.

26 On these mosaics, see E. Thunø, 'Decus suus splendet ceu Phoebus in Orbe – Zum Verhältnis von Text und Bild in der Apsis von Santa Maria in Domnica in Rom', in B. Janowski and N. Zchomelidse (eds), *Die Sichtbarkeit des Unsichtbaren. Zur Korrelation von Text und Bild im Wirkungskreis der Bibel*, Stuttgart, 2002, 147–64; E. Thunø, 'Materializing the invisible in Early Medieval art: the mosaic of Santa Maria in Domnica in Rome', in G. de Nie, K.F. Morrison and M. Mostert (eds), *Seeing the Invisible in Late Antiquity and the Early Middle Ages, Papers from "Verbal and Pictorial Imagining: Representing and Accessing Experience of the Invisible, 400–1000"* (Utrecht, 11–13 December 2003), Turnhout, 2005, 265–79, with references to earlier bibliography; see also F. Svizzeretto, 'Il mosaico absidale manifesto iconodulo: proposta di interpretazione', in A. Englen (ed.), *Caelius I: Santa Maria in Domnica, San Tommaso in Formis e il Clivus Scauri*, Rome, 2003, 241–56.

27 I am most grateful to Dr Maurizio Campanelli for this suggestion (and discussion of possible alternatives), and to Prof. Michael Reeve for confirming the validity of this amendment. The presence of such a trivial error is difficult to explain. We should exclude the hypothesis that the mistake dates to Paschal I's time. Within the learned cultural milieu of the 9th-century papal circle, De Rossi's hypothesis of the crude style of the versifier cannot be accepted (G.B. De Rossi, *Mosaici cristiani e saggi dei pavimenti delle chiese di Roma anteriori al secolo XV*, Rome, 1899, unnumbered page, clearly influenced by the 'Dark Age' perspective). Also, since the pope had invested so much in this mosaic (which was ultimately meant to promote his role as ruler of Rome and intercessor between the faithful and the divine), had the mistake been made by the mosaicist, it would have been rectified. No visible trace of remaking is discernable, hence the error is not a result of a modern intervention either. In addition, the earliest known transcription of the text (by Pietro Sabino, late 15th century) is identical to the extant inscription (De Rossi ibid., unnumbered page). This means that the alteration of the text must have taken place before then. Thus, the most likely hypothesis is that 'post' is the result of a medieval restoration, dating from a time when the visual integrity of the mosaic must have mattered more than the preservation of the actual original message.

28 For alternative translations, not taking into account the issue of the corruption of the inscription, see R. Wisskirchen, 'Santa Maria in Domnica. Überlegungen zur früheste apsidialen Darstellung der thronenden Maria in Rom', *Aachener Kunstblätter* 61 (1995–97), 381–93, esp. 382, n. 9; Thunø 2002 (n. 26), 144, n. 393; R. Favreau, *Épigraphie médiévale*, Turnhout, 1997, 116; Goodson (n. 17), 153.

29 See the discussion in Borsook (n. 14), 4–5.

30 The *metallum ligneum* is found in the *Acta Sanctorum Ordinis Sancti Bendicti*, III, 2, 17; a *scyphum ex metallo corallo* is mentioned in the *LP*, I, 34: 10; and the *pretiosis marmorum metallis* are recorded in the *Vita Severi episcopi Neapolitani* (written before the 9th century), ed. by Capasso, *Monumenta*, 1881, I, 273, 1.

31 Martianus Capella, *De nuptiis Mercurii et Philologiae*, 1, 16: *quattuor urnulas… quae diversa specie metallisque formatae (scilicet e ferro, argento, plumbo, vitro)*.

32 See, for instance, *LP*, II, 100: 11, for the specific case of Santa Maria in Domnica.

33 Ibid., 100: 11.

34 The medieval Christian notion of light as an embodiment of the divine goes back, at least, to the Bible (John 8:12; Matthew 4:16) and was elaborated upon by the Church Fathers, such as Augustine and Ambrose, becoming a central notion in Christian theological writings. One of the most influential and widely read texts, the 5th/6th-century *Celestial Hierarchy* by Pseudo-Dionysius, describes the sun as 'the visible image of divine goodness which all material things desire' and 'material lights' as 'images of the outpouring of an immaterial gift of Light'. In Pseudo-Dionysius' writings, the heavenly and the physical are perceived as complementary, and the emphasis on the sparkle of metals, especially gold and silver illustrates this clearly. See James (n. 11), 100, and J. Gage, 'Gothic glass: Two aspects of a Dionysian aesthetic', *Art History* 5 (1982), 36–57.

35 Christ sits on a band of azure tesserae marked off from the azure mandorla by white borders. He is literally shown 'in orbe'. Like the word *orbs/orbis*, the double band on which Christ rests evokes multiple associations: with the globe, the rainbow, and the solar orbit. For its reading as a representation of the globe, see W. W. S. Cook, 'The earliest Painted Panels of Catalonia (II)', *Art Bulletin* 6 (1923), 31–60, esp. 38–60. For the reading of similar 'seats' of Christ in mandorlas in Byzantine art as non-naturalistic rainbows, symbolising divine light and glory, see James (n. 11), 92–109.

36 On images and iconoclasm, see T. Noble, *Images, Iconoclasm and the Carolingians*, Philadelphia, 2009.

37 Ermoldus Nigellus, *Carmen in Honorem Hludovici Imperatoris*, in *Patrologia Latina*, J.-P. Migne (ed.), *Patrologiae Cursus Completus*, Series Latina, 221 vols, Paris, 1841–64, I, vol. 105, book II, col. 0591A (hereafter *PL*).

38 Ibid., book IV, cols. 0623D-0634C. Equally, the author of the inscription (presumably himself a poet) must have been familiar with contemporary as well as earlier poetry. The verse 'QVI POST FVRVA FVGANS TETRAE VELAMINA NOCTIS' is the most reminiscent of poetical writings. Thunø 2005 (n. 26), 276, n. 22, following Peter Dronke's suggestion, mentions Arator, *Historia Apostolica* 2, 1125, as a source of inspiration: *Lux revocata micat, velamine noctis aperto*. Since what matters is not only the recurring of the words but also their position in the verse, one could add Martianus Capella, *De nuptiis Mercurii et Philologiae* 6, 585: *sic igitur furvae oculos splendescere noctis*, and Paolinus of Petricordia, *De vita sancti Martini* 5, 368: *occurrit tetrae disrumpens nubila noctis*. As both Martianus and Paolinus were well known at the time, it would appear that the learned versifier of Santa Maria in Domnica constructed the verse by combining various passages which were echoing in his poetic memory. I am indebted to Dr Maurizio Campanelli for both citations and comments.

39 Borsook (n. 14).

40 See C. Bolgia, *S. Maria in Aracoeli and the Franciscans in Rome (c. 1250–1400)*, Ashgate, chapter 2, forthcoming.

41 Ch. Hülsen, 'The legend of Aracoeli', *Journal of the Archaeological Society of Rome* 4 (1907), 45–7; B. Pesci, 'La leggenda di Augusto e le origini della chiesa di S. Maria in Aracoeli', in *Incoronazione della Madonna d'Aracoeli*, Rome, 1938, 18–33.

42 The Greek text is published by Pesci (n. 41), 24, n. 3. On both the eastern and western versions of the legend, see E. Cerulli, *Il libro etiopico dei miracoli di Maria e le sue fonti nelle letterature del Medio Evo latino* (Studi Orientali, 1), Rome, 1943, 408–20.

43 *Biblioteca Apostolica Vaticana*, MS Pal. Lat. 277, fol. 63^{rv}: '[...] Qui exiens inde Augustus Caesar a divinationem et veniens in Capitolium aedificavit ibi aram magnam in sublimiori loco, in qua iscripsit latinis litteris dicens: haec aram filii dei est. *Unde factum est post tot annis domicilium adque basilicam beatae et semper virginis Mariae* usque in praesentem diem, sicut et Timotheus chronographus commemorat' [my italics]. The passage in italics was added by the Latin author and does not appear in Malalas's *Chronicon*.

44 For the full text in Latin see R. Valentini and G. Zucchetti, *Codice topografico della città di Roma*, Rome, 1940–53, 4 vols, vol. III, 3–65, esp. 29.

45 The most recent critical edition of this extremely popular work is G.P. Maggioni (ed.), *Jacopo da Varazze (Jacobus Da Voragine), Legenda Aurea*, 2 vols, Florence, 1998. This version, at 69–70, is the one cited here: *in die media circulus aureus apparuit circa solem et in medio circuli Virgo pulcherrima*…. For an English translation see, among others, *The Golden Legend of Jacobus da Voragine*, trans. and adapt. by G. Ryan and H. Ripperger, New York, London and Toronto, 1969, 49.

46 C. D'Onofrio, *Renovatio Romae: Storia e urbanistica dal Campidoglio all'EUR*, Rome, 1973, 58–9.

47 Vatican Library, Barb. Lat. 2300: *Circulus etiam aureus circa solem in media die apparuit et virgo in medio puerum in gremio tenens.*

48 Orosius, *Adversos Paganos*, VI, 20 (*Corpus Scriptorum Ecclesiasticorum Latinorum V*): *circulus ad speciem caelestis arcus orbem solis ambiit.*

49 For a full and comprehensive discussion of this point, see Bolgia (n. 40), chapter 2.

50 The site was granted to the Franciscans by Pope Innocent IV with the *Dilecti filii fratres* of 12 July 1249, published in J.H. Sbaralea (ed.), *Bullarium franciscanum romanorum pontificum*, I, Rome, 1759, 530–1, nr. 304.

51 R. Malmstrom, 'S. Maria in Aracoeli at Rome' (unpublished doctoral dissertation, University of New York, 1973), and idem, 'The twelfth-century church of S. Maria in Capitolio and the Capitoline obelisk', *Römisches Jahrbuch für Kunstgeschichte* 16 (1976), 1–16. Malmstrom believed that the *confessio* was part of the pre-Franciscan ensemble; for a different interpretation see Bolgia (n. 40), chapter 2.

52 *Laus in venerabilem dormitionem sanctissimae ac intemeratae Dominae nostrae Dei genetricis semperque virginis Mariae in Latinum translata, ex codice Augiensi LXXX*, published in the *Continuatio medievalis*, vol. 154, ed. A. P. Orban, 135–49, where Mary, *mater luminis*, is contrasted to Eve, *mater pulveris*; for the *Libellus* see *PL*, 16, vol. 176, chapter 1, column 0857B.

53 On the transmission of Virgil in the Middle Ages, see D. S. Wilson-Okamura, *Virgil in Late Antiquity, the Middle Ages and the Renaissance: an on-line bibliography* at http://virgil.org/bibliography/ On the reception of the *Aeneid* see namely J. M. Ziolkowski, 'Mnemotechnics and the Reception of the *Aeneid* in Late Antiquity and the Middle Ages', in P. Knox and C. Foss (eds), *Style and Tradition: Studies in Honor of Wendell Clausen* (Beiträge zur Altertumskunde 92), Stuttgart, 1998, 158–73.

54 http://www.treccani.it/enciclopedia/fauno/ [accessed on 2.01.2010].

55 From the 14th century onwards the 'Aracoeli Virgin' – that is the Virgin of the vision to the emperor – would often acquire the attributes of the Virgin clothed with the sun, such as the crescent moon. The image on the *confessio* seems to be a representation *ante litteram* of such a conflation of images. For a fuller discussion of the Virgin's innovative iconography, see Bolgia (n. 40), chapter 2.

56 An engraving published in Father Casimiro da Roma O.F.M., *Memorie istoriche della chiesa e del convento di S. Maria in Aracoeli di Roma*, Rome, 1736, on an unnumbered page in between pp. 160 and 161, attests that the upper border of the *confessio*, between the two lines of the inscription, was also originally filled in with mosaic, already partially lost at the time. Unfortunately, the engraving only reproduces the mosaic in summary form, without providing any detail of its original pattern.

57 This image and other relevant examples are published in H.L. Kessler, *Spiritual Seeing: Picturing God's Invisibility in Medieval Art*, Philadelphia, 2000, pl. III; see also the images illustrating 53–63 and 88–103.

58 Exodus 26, 31–3. Herbert Kessler discusses the veil of the

tabernacle in Christian exegesis in a number of essays, collected in Kessler (n. 57); see especially chapter 3, 'Medieval art as argument', 53–63, and chapter 5, 'Gazing at the future: The *Parousia* miniature in Vatican Cod. Gr 699', 88–103. See also P. Hills, *The Renaissance Image Unveiled: From Madonna to Venus* (The Watson Gordon Lecture 2009), Edinburgh, 2010, 11–12.

59 See Hebrews 10:19–20 and II Corinthians 3:12–18. For Christ's flesh as the veil, see Kessler and Hills as in n. 58.

60 Thunø 2005 (n. 26), 276.

Chapter 21
The Absence of Glass
Talking about the Mosaics at Porta Panagia in Thessaly, Greece

Maria Vassilaki

The papers in the present volume focus on the study of glass and mosaics and of gold glass mosaic tesserae in particular. However, in this paper I have deliberately chosen to focus on a mosaic decoration in which not a single gold glass mosaic tesserae is reported to have been used. If this is really the case, then it is extremely unusual for the last decades of the 13th century, the period to which this mosaic decoration belongs. But first of all, do we accept as fact the information offered so far, that no gold glass mosaic tesserae were ever used for these mosaics? And second, if this is the case, how can we explain the absence of gold glass mosaic tesserae at such a late date? My aim is to look at the mosaic decoration of Porta Panagia in Thessaly and discuss its case.[1]

Let's start from the beginning. The church is located outside the village of Pyli in Thessaly, which is in mainland Greece. The name of the modern village, Pyli, reflects its Byzantine name and function, Μεγάλαι Πύλαι (Great Gates), as this was one of the main passages that led from Thessaly to Epirus. The church is dedicated to the Invincible Mother of God of the Great Gates, in Greek Θεοτόκος Ακαταμάχητος των Μεγάλων Πυλών, and is today commonly known as Porta Panagia (Porta is the door, the gate). It is a monumental architectural type (**Pl. 1**) in the form of a cross-vaulted three-aisled basilica with an exonarthex to the west (**Pl. 2**), and it is believed to have been

Plate 1 The church of Porta Panagia in Thessaly, general view from the northeast

Plate 2 Porta Panagia, Thessaly, general view from the northwest

Plate 3 Detail of Holy Bishops in the conch of the sanctuary apse, Porta Panagia, Thessaly

Plate 4 St John Chrysostom and St Athanasios, detail of plate 3, Porta Panagia, Thessaly

added much later mainly because a major part of the church structure was reconstructed in 1743 following a devastating flood.[2] A recent re-examination of the architecture of the church, however, has shown that the exonarthex is no later than the mid-14th century.[3]

No dedicatory inscription has survived *in situ* in the church but it seems that there was one originally, if we are to believe the information offered by later mentions in two manuscripts, which claim to copy the dedicatory inscription of Porta Panagia. The first manuscript is a version of the Gospel that once belonged to the church of Porta Panagia. It is dated to the 14th century and is preserved today in the National Library in Athens (no. 84, f. 148).[4] The second manuscript dates back to 1788 and is from the monastery of St Panteleimon on Mount Athos (f. 1v of codex 739).[5] From these two references we learn that the church was founded by the *sebastokrator* Ioannis I Angelos Komnenos Doukas in the 11th indiction of the year 1283. He was the illegitimate son of the despot of Epiros, Michael II Angelos Komnenos Doukas. According to Byzantine historians,[6] among whom Nikephoros Gregoras gives the most detailed account,[7] before dying Michael divided his despotate between his two sons. Nikephoros, who was the legitimate son, took the region of Epirus with Arta as his capital, and Ioannis took Thessaly using Neopatras (modern Ypati) as his capital.

What remains today of the original decoration of the church are two monumental mosaic icons of Christ and the Virgin with the Christ Child on the two piers flanking the sanctuary screen,[8] and some wall-paintings. These frescoes mainly cover the conch of the sanctuary apse.[9] What we see today in the apse are the full standing figures of various bishops (**Pls 3**–**4**), such as St Gregory the Theologian, St Basil, St John Chrysostom and St Athanasios. It is unusual to have these bishops in the sanctuary simply standing as they do and not as officiating bishops indicating participation in the liturgy. The marks that are visible all over their figures come from the time when they had been re-plastered. There is one more fresco representation in the church, on the tympanum of an arcosolium on the south wall of the main church, which is believed to have been the burial place of the founder, *sebastokrator* Ioannis. It is the scene with the archangel Michael holding the hand of a deceased monk and guiding him to the enthroned Virgin and Child (**Pl. 5**) that has become the main focus in the church.[10] Although there is no conclusive evidence to believe that the deceased monk is the *sebastokrator* Ioannis himself, many scholars seem to believe this. I do not think that it is the eponymous

Plate 5 Detail of the tomb on the south wall with a funerary scene on the tympanum of its arcosolium, Porta Panagia, Thessaly

Plate 6 General view of the marble templon screen with two monumental mosaic icons on its adjacent piers, Porta Panagia, Thessaly

Plate 7 (left) Detail of the monumental mosaic icon of Christ Pantocrator on the left pier, Porta Panagia, Thessaly

Plate 8 (right) Detail of the monumental mosaic icon of Christ Pantocrator on the left pier, Porta Panagia, Thessaly

Plate 9 (left) The Gospel book in Christ's left hand, detail of plate 7, Porta Panagia, Thessaly

Plate 10 (right) The Virgin and Christ Child, detail of plate 8, Porta Panagia, Thessaly

sebastokrator represented here. Firstly because he never became a monk, so why should he be represented as one? Secondly, because this funerary scene cannot be stylistically dated to around 1289, the year in which the *sebastokrator* died, but is instead of a later date.

The frescoes in the sanctuary apse appear to be of the same date as the two mosaic representations – that is between 1283, the year that the church was erected according to its dedicatory inscription and 1289, the year of the *sebastokrator's* death – while the funerary scene must be of the mid-14th century.

It seems that the only mosaic decoration that ever existed in the church is that of the two monumental icons on the piers on either side of the templon screen (**Pl. 6**).[11] Christ Pantocrator is on the left (**Pl. 7**) and the Virgin holding the Christ Child on the right (**Pl. 8**). They are both surrounded by an elaborate marble arched frame, which underlines their role as monumental icons. On such occasions, it is common to have Christ represented on the right and the Virgin on the left of the templon screen but here their positions are reversed.[12] When I first visited the church at Porta Panagia, the keeper of the key, a local woman full of stories about the church, explained to me that the mosaicist who made these two representations had aimed to place the Virgin to the left. He started making the figure of the Virgin holding the Christ Child and when he woke up the next morning he found that the Virgin had moved to the other side. He started all over again placing the Virgin and Child on the pier to the left but to his surprise the next morning she was again on the right. For a whole week he struggled to put the Virgin on the left but she kept moving herself to the right. So the woman concluded by saying that the mosaicist had to give up in the end as it became obvious to him that it was the Virgin's wish to see herself to the right of the templon screen. I love these stories and made no effort to tell her that while this is not very common, it does happen in other churches as well, such as the main church of the Chora monastery in Constantinople of around 1320.

Both Christ and the Virgin are shown full length. They were both originally standing on a footstool but that of the Virgin has not survived. Christ is holding an open book (**Pl. 9**) with the phrase from St John's Gospel (John 8:12): 'Εγώ ειμί το φως του κόσμου ο ακολουθών [εμοί ου μη περιπατήση εν τη σκοτία, αλλ' έξει το φως της ζωής]' ('I am the Light of the world: he that followeth me [shall not walk in darkness, but shall have the light of life']). The Virgin is holding the Christ Child and she is in fact a full-length Hodegetria type after her renowned icon in the Hodegon monastery in Constantinople. She is holding Christ to her right (**Pl. 10**) and not to her left as in the Hodegetria icon, but this conforms to the fact that Christ

Plate 11 General view of the interior of Porta Panagia, Thessaly, taken in 1966 (from the archive of Yannis Kolefas)

Plate 12 Photographs during the restoration of the monumental mosaic icon of Christ Pantocrator at Porta Panagia, Thessaly, taken in 1966 (from the archive of Yannis Kolefas)

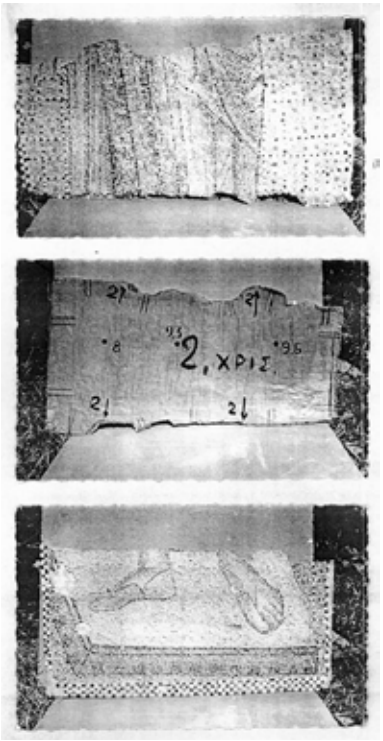


Plate 13 Photographs during the restoration of the monumental mosaic icon of Christ Pantocrator at Porta Panagia, Thessaly, taken in 1966 (from the archive of Yannis Kolefas)

himself is standing to the left. The question as to whether the same workshop executed both the fresco and the mosaic decoration of this church still remains open, but I strongly believe this to be the case.

These two mosaic representations were restored in 1964 by the late Yannis Kolefas, the chief mosaic conservator in the Greek Archaeological Service.[13] With the help of his daughter, who has also become a mosaic conservator, I was able to dig into her father's archive and pull out some information regarding his restoration work at Porta Panagia. He only discusses the work that he undertook for the cleaning and consolidation of the two mosaic representations. I also found the black-and-white pictures that he had taken on the occasion. These were not the days of digital photography so only a few pictures were taken. A few show how the church looked like before he started restoring it (**Pls 11**–**12**). Another comes from an old xerox of the original pictures and shows that the mosaics were removed so that the supporting wall would be consolidated (**Pl. 13**). Apart from consolidating and restoring these mosaics Yannis Kolefas made two exact copies of the marble templon screen and the mosaic icons of Porta Panagia (**Pl. 14**), all of which were displayed at the Byzantine exhibition titled 'Byzantine Art, an European Art', which took place that same year, 1964, at the Zappeion Palace in Athens.[14]

When looking at the two mosaics it becomes obvious that for the background and the haloes of Christ (**Pl. 15**), the Virgin (**Pl. 16**) and the Christ Child no gold glass mosaic tesserae were used. Cubes of sandstone in a yellowish colour were used instead. One can only detect recycled glass for the black tesserae (**Pls 17**–**18**). How can we then explain the absence of gold glass mosaic tesserae? Could this mean that the mosaic workshop did not have access to gold glass tesserae? And why not? It is hard to believe that the absence of gold glass tesserae was motivated by cost-cutting, as this does not fit with the status of the donor of the church, the

Plate 14 A replica of the marble templon screen of Porta Panagia, Thessaly, made by Yannis Kolefas

sebastokrator Ioannis. Are glass tesserae a sign of luxury? Is glass more expensive than sandstone?

One is tempted to compare the mosaics of Porta Panagia with those of the Parigoritissa in Arta, which date to the 1290s and more specifically between 1291 and 1296.[15] They are very close in date and, according to a dedicatory inscription, the church of Parigoritissa was built by the despot of Epiros, Nikephoros and his wife Anna Palaiologina.[16] This means that the two monuments, that of Porta Panagia and of the Parigoritissa, are connected to the two brothers, Nikephoros the despot of Epiros and Ioannis the despot of Thessaly. We do find stylistic similarities between the mosaics of the two monuments, as, for example, in the prophets of the Parigoritissa dome and the Virgin in Porta Panagia. What we need to understand, however, is whether there is any connection between the workshop that worked in Porta Panagia with that of the one in Parigoritissa. Such a connection does not seem to exist. One has to admit that the mosaics in Porta Panagia have a coarse quality both in their technique and their execution when compared to those of the Parigoritissa. In the mosaic decoration of the Parigoritissa, which is much more extensive than the two representations in Porta Panagia, there is an abundant use of gold glass mosaic tesserae. We

Plate 15 (left) Detail of plate 7 showing part of Christ's halo, Porta Panagia, Thessaly

Plate 16 (right) Detail of plate 8 showing part of the Virgin's halo, Porta Panagia, Thessaly

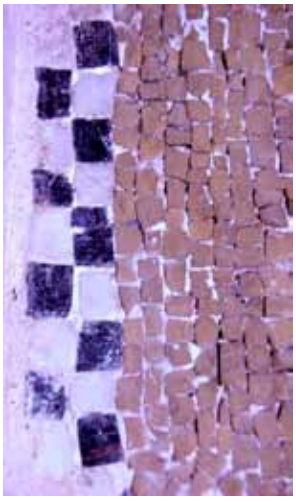


Plate 17 Detail of plate 8 showing the garments from the lower part of the Christ Child and the Virgin, Porta Panagia, Thessaly

Plate 18 Detail of plate 17 showing the use of recycled glass for the black tesserae, Porta Panagia, Thessaly

are unable to answer the question where the gold glass mosaic tesserae of the Parigoritissa had come from.

Could the absence of gold glass mosaic tesserae from Porta Panagia mean that they originally existed but were removed at a later date and replaced with tesserae of sandstone? If they had removed the gold glass tesserae, why should they bother to replace them? Just to give an example, in the church of the Holy Apostles in Thessaloniki (*c.* 1315), wherever the gold glass mosaic tesserae were removed from the mosaics, they were never replaced with a substitute.[17]

This is a preliminary report on research that has just begun on the scientific analysis of the tesserae used for the two mosaic representations in Porta Panagia. I hope that with the help of technology I will be able soon to provide more conclusive evidence to explain the absence of glass mosaic tesserae from this monument and the reasons why.

Notes

1 The first study dedicated to the architecture and monumental decoration of Porta Panagia dates back to 1935: A. Orlandos, 'Η Πόρτα-Παναγιά της Θεσσαλίας', Αρχείον των Βυζαντινών Μνημείων της Ελλάδος 1 (1935), 5–40. See also, J. Koder and F. Hild, *Hellas und Thessalia*, Tabula Imperii Byzantini I, Vienna, 1976, 245–6; Ch. Bouras and L. Boura, *Helladic Church-Building during the 12th Century*, Athens, 2002, 273–4.

2 P. Magdalino, *The History of Thessaly, 1266–1393*, Oxford, 1976, 48–9.

3 S. Mamaloukos, 'The chronology of the exonarthex of the Porta-Panagia in Thessaly', in I. Stevović (ed.), *ΣΥΜΜΕΙΚΤΑ. Collection of Papers dedicated to the 40th anniversary of the Institute for Art History, Faculty of Philosophy, University of Belgrade*, Belgrade, 2012, 237–49.

4 A. Avramea and D. Feissel, 'Inventaires en vue d'un recueil des inscriptions historiques de Byzance. IV. Inscriptions de Thessalie (à l'exception des Météores)', *Travaux et mémoires* 10 (1987), 380–1.

5 Orlandos (n. 1), 7–10.

6 Georgii Acropolitae, *Opera*, A. Heisenberg (ed.), Leipzig, 1903, 170–1. Georgii Pachymeres, *De Michaele et Andronico Palaeologis Libri XIII*, I. Bekker (ed.), Bonn, 1835, 1, 307–8.

7 Nicephori Gregorae, *Byzantina Historia*, L. Schophen and I. Bekker (eds), 1, Bonn, 1829, 110–11.

8 N. Chatzidakis, *Byzantine Mosaics*, Athens, 1994, 25, nos 162–3, pls 162–4.

9 A. Tsitouridou, 'Les fresques du XIIIe siècle dans l'église de la Porta-Panaghia en Thessalie', in *Actes du XVe Congrès International d'Études Byzantines (Athènes, Septembre 1976), II. Art et Archéologie. Communications B*, Athens, 1981, 863–78.

10 M. Chatzidakis, 'Βυζαντινόν και Χριστιανικόν Μουσείον. Πόρτα Παναγιά', *Archaiologikon Deltion* 22 (1967), Chronika, 24–5, pls 33–8; Tsitouridou (n. 9), 876–7, fig. 9; Ch. Machairas, *The Church of Porta Panagia in Pyli Trikkalon and its Funerary Scene*, M. Phil., University of Birmingham, Centre for Byzantine, Ottoman and Modern Greek Studies, Birmingham, 2008.

11 Chatzidakis (n. 8), 25, nos 162–3, pls 162–4.

12 The mosaic representations of Christ and the Virgin on either side of the sanctuary apse in the katholikon at the Chora monastery (Kariye Çamii) in Istanbul are also placed with Christ on the left pier and the Virgin on the right pier: P.A. Underwood, *The Kariye Djami, vol. 2: The Mosaics*, New York, 1966, pl. 4.

13 P. Lazarides, 'Μεσαιωνικά μνημεία Θεσσαλίας. Πόρτα Παναγιά', *Archaiologikon Deltion* 20 (1965), B2. Chronika, 324.

14 *Byzantine Art, an European Art, 9th Exhibition of the Council of Europe*, Zappeion Palace, Athens, 1964.

15 A. Orlandos, *Η Παρηγορήτισσα της Άρτης*, Athens, 1963; H. Belting, 'The Style of the Mosaics', in H. Belting, C. Mango and D. Mouriki, *The Mosaics and Frescoes of St. Mary Pammakaristos (Fethiye Camii) at Istanbul*, Washington DC, 1978, 97–100, fig. 123; Chatzidakis (n. 8), 25, pls 156–61; B. Papadopoulou, *Η Βυζαντινή Αρτα και τα μνημεία της*, Athens, 2002, 131–61, figs 177–8.

16 S. Kalopissi-Verti, *Dedicatory Inscriptions and Donor Portraits in Thirteenth-Century Churches of Greece*, Vienna, 1992, no. A.7, 53–4, figs 11–14.

17 A. Xyngopoulos, *Η ψηφιδωτή διακόσμησις του ναού των Αγίων Αποστόλων Θεσσαλονίκης*, Thessaloniki, 1953, pls 1–6; Belting (n. 15), 96, 98, 100–1, fig. 118; C. Stephan, *Ein byzantinisches Bildensemble. Die Mosaiken und Fresken der Apostelkirche zu Thessaloniki*, Worms, 1986, figs 6–24.

Chapter 22
Borders of Experimentalism
Glass in the Frame of the Genoa Mandylion

Francesca Dell'Acqua

The Mandylion icon from the monastery of San Bartolomeo degli Armeni in Genoa is encased within two bejewelled frames of different dates (1601 and 1702), and a Palaiologan filigree and enamelled repoussé frame lined with a delicate Byzantine silk (**Pls 1–3**). The Palaiologan frame circumscribes a three-pointed, dark face of Christ painted on wood, with a painted red cross on the verso. The object reveals an irresistible capacity to engage the viewer in an intense visual, tactile, even olfactory appreciation, which could function as an effective prelude to an intimate spiritual experience.[1]

The most attractive part of this icon-relic is, undoubtedly, the Palaiologan frame with ten narrative plaques recalling the early story of the Mandylion before its arrival in Constantinople in AD 944 (**Pl. 4**). This frame displays technical features that are – as far as is known – unique in the history of enamelling, specifically multicoloured enamel placed in minute grooves on ten gilded, chiselled and repoussé narrative plaques that measure only approximately 42 x 42mm (**Pl. 5**). The narrative displayed on the plaques is clarified by tiny inscriptions in niello, based on various literary sources. For this paper, I wish to emphasize the experimentalism of this frame, which seems appropriate to the uniqueness of its central image, the Holy Face of Edessa, presented in the Christian tradition as the 'true likeness' of the living Christ, which required a unique framing.

A unique kind of enamelling

The kind of enamels to be found in Byzantine art have been classified in three categories: cloisonné, in other words

Plate 1 Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, panel painting with gilded silver, enamels and precious and semi-precious stones, 14th century (silver case 1601 and external bejewelled frame 1702), 400 x 295 x 30mm

Plate 2 Silver case of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, 1601, 390 x 290 x 25mm

Plate 3 Bejewelled frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver, diamonds and semi-precious stones, 1702, 400 x 295 x 30mm

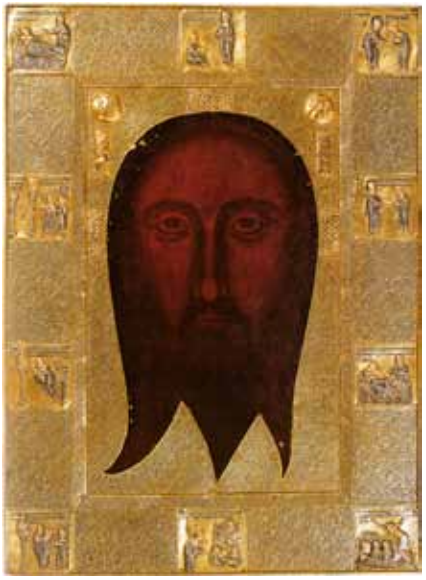


Plate 4 Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 384 x 282 x 45mm

Plate 5 Detail of the third scene of the narrative showing Jesus washing his face from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

powdered glass set into cloisons of thin metal strips, whose origins have been proved by David Buckton to be western;[2] champlévé, which is powdered glass set into purposely depressed metal plaques, whose higher parts were meant to be visible in such a way as to contribute to the design, this latter technique having appeared in the 10th century; and enamel on bas-relief repoussé metal. Between the 10th and 12th century, the art of enamel reached its apex in Byzantium, with unsurpassed masterpieces characterized by a spectacular employment of goldsmithing expertise. Enamelled objects, whose artistic excellence was reputed to be appropriate for imperial patronage, were often involved in a complex ritual of gift-exchange with foreign courts, acting as powerful messages of the complexity, and therefore superiority, of Byzantine art and culture.[3]

The Genoa frame has been compared as regards to its figurative repoussé and decorative filigree with two book covers from the Biblioteca Marciana in Venice (cod. gr. I,53 and cod. gr. I,55) (**Pls 6–7**), with two revetted icons of the Virgin and the Crucifixion in the Vatopedi monastery on Mount Athos (**Pl. 8**) and the Passion reliquary casket in the Ospedale di Santa Maria della Scala in Siena (**Pl. 9**).[4] On this occasion I wish to point out that none of these

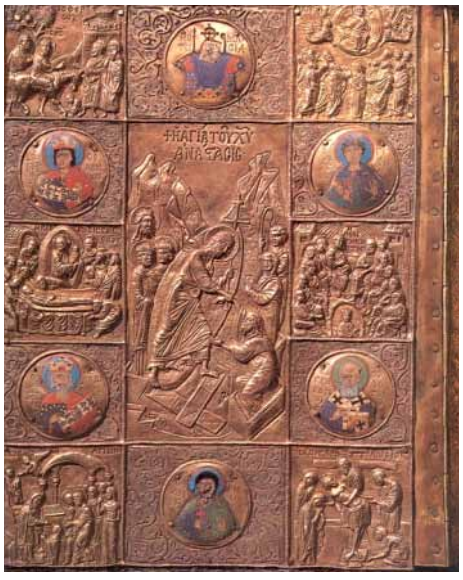


Plate 6 Detail of book cover, Biblioteca Marciana, Venice (cod. gr. I,53), silver and enamels, 14th century

Plate 7 Detail of book cover, Biblioteca Marciana, Venice (cod. gr. I,55), 14th century

Plate 8 Mosaic depicting the Crucifixion, monastery of Vatopedi, Mount Athos, gilded silver and micro-mosaic, 14th century

Plate 9 Passion reliquary casket, Ospedale di Santa Maria della Scala, Siena, gilded silver, 14th century

comparative objects have repoussé metal plaques with grooves filled with enamels, as the Genoa frame does. In fact, on the frame of the Genoa Mandylion the enamel appears embedded in tiny grooves of the gilded repoussé surface, which is not attested anywhere else. The Genoa narrative plaques, despite their small dimensions (42 x 42mm), seem vaguely inspired by Late Antique bas-relief sculpture, with solidly built, draped figures, with a dignified, but expressive appearance and measured gestures.[5] In the central scene of the upper side of the frame, the second in the narrative sequence, the body of a standing Christ emerges from the surface of the repoussé plaque more than any other feature in the whole narrative cycle, reaching about 3–4mm in height from the surface level. Christ's left knee, enhanced by spiral grooves darkened with niello is the highest point of the entire repoussé relief of the frame (**Pl. 10**). Christ's prominent physical appearance,[6] here emphasized by technical means, eludes the attempt by Ananias, King Abgar's envoy, to portray Christ's likeness. This can be recognized as the focal scene of the narrative programme as it alludes to the reason why Christ finally decides to reproduce his own likeness by wiping his face, as seen in the next scene, the product of which is visible on the central painted icon of the Mandylion. Other parts characterized by higher relief in the narrative plaques are the right knee of Christ in the two following scenes and the knee of Abgar in the first scene (**Pl. 11**), all of which are enhanced in the drapery with a spiral groove. The physical prominence of the aforementioned knees, all enhanced by enamel, may perhaps refer on the one hand to the ritual kissing of the knee of the *basileus* in the coronation ceremony, and on the other to the gestures involved with the cult practices of holy icons, where the ritual kiss (*aspasmos*) was accompanied by the lighting of candles, making the sign of the cross and prostrating oneself (*proskynesis*).[7]

The draperies in the Genoa plaques, responsible for constructing the physical appearance of the figures – apart from the extraordinary, half-naked possessed man in the last scene – have often been traced with closely parallel lines, sometimes 'V' shaped, sometimes curling, in which either opaque red, emerald green, blue glass or niello have been embedded. Niello appears to have been applied to strengthen the effects of the chiselling on the repoussé surface, but also to create a darker background for the

Plate 10 Detail of the second scene of the narrative showing Abgar trying to portray Jesus' likeness, from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

Plate 11 Detail of the first scene of the narrative showing Abgar in his bed, from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

Plate 12 Detail of the seventh scene of the narrative showing the bishop installing the Mandylion, from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

Plate 13 Detail of the ninth scene of the narrative showing the bishop releasing Edessa from the Persian siege, from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

application of enamels, as the loss of the glass paste as the green sea of the last scene has revealed in some instances. On the right arm of Christ in the third scene, where he is washing his hands, the drapery is enhanced by an emphatic, almost hypnotic spiral and by the use of two intense colours in the enamelling: bright red and blue/green (**Pl. 5**). The emerald green in the background of Christ's cruciform nimbus in the second scene is also emphatic, especially as the three arms of the cross are black (**Pl. 10**); these colours appear inverted in the two following scenes. The small size of the plaques (42 x 42mm), and the relative inaccessibility of the Genoa Mandylion, have meant that scholars who wrote about it used a different terminology when describing the colours of the enamels.[8] Besides the above-mentioned enamel colours, all of which are opaque, white has also been used on the bishops' *omophoria* (a band of material decorated with four crosses worn about the neck and shoulders) in the last four scenes (**Pl. 12**), and the translucent brown in Abgar's bed cover in the first and the fifth scene (**Pl. 11**). On some of the furniture, such as Abgar's bed in the fifth scene as well as on the architectural details of the city of Edessa in the sixth, seventh, eighth and ninth scenes (**Pl. 13**), the richness of the enamels is extraordinary. This is especially pertinent if one thinks about the minute dimensions of the plaques and the difficulty involved, after firing, of polishing this kind of enamel embedded in the smallest grooves of the repoussé surface. The opaque, but intense red, which appears on several scenes of the frame as the colour that brightens, even 'enlivens' the compositions (**Pl. 14**), deserves further comment as it has been 'generally acknowledged to be among the most technically demanding of the colours produced by early glassmakers'.[9] But opaque red glass could be made relatively easily by adding ground cakes of litharge, a by-product of precious metal purification. Whether or not this was the case for the Palaiologan frame, the opaque red, as well as the other colours of its enamels, might have been more easily obtained by simply grinding old glass mosaic tesserae, which was the usual practice in the medieval West.[10] In fact, although Jannic Durand favoured the idea of 'new' glass produced specifically for Byzantine enamels,[11] analyses made on Byzantine enamelled objects in the collection of the British Museum show they were clearly derived from re-used Roman glass mosaic tesserae, not contemporary ones. As regards to the provenance of these tesserae, a forthcoming study by Ian Freestone and his collaborators states that both eastern and western enamellers recycled Roman glass for their work, although strangely it seems that 'the Byzantine craftsmen appear to have neglected sources of coloured glass, such as mosaics, from their own region. They may have utilized essentially the same sources as the western enamellers, through an international trade in raw materials.' In fact, 10th-century coloured glasses produced for mosaics were opacified with quartz instead of tin or antimony, and therefore were not suitable for enamelling, as quartz affects the melting temperature and the viscosity of glass, making it more difficult to melt and much less fluid.[12] However, while a series of scientific investigations involving C14-dating were carried out on the Genoa Mandylion on the occasion of an exhibition in 2004,[13] analyses of the enamels that could eventually confirm the use of antique tesserae are still awaited.

The majority of the metal backing-plates in 14th-century enamel works, as is also the case in the Genoa frame, were made of silver, while in earlier times they were typically alloys of copper or gold, mainly for technical reasons. In fact the melting temperature of silver (*c.* 961 EC) is lower than those of gold (*c.* 1064 EC) and copper (*c.* 1081 EC), therefore, 'to produce enamels by recycled tesserae with typical Roman soda-lime-silica glass, which has a melting temperature of 930 EC and a softening point of 700 EC, would have required temperatures approaching the melting point of silver and required extremely careful control of the

Plate 14 Detail of the seventh scene of the narrative showing the bishop installing the Mandylion, from the Palaiologan frame of the Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, gilded silver and enamels, 14th century, 42 x 42mm

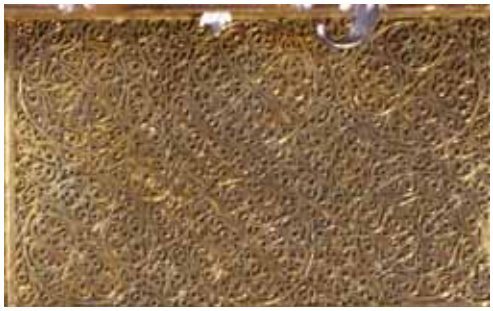


Plate 15 Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, Palaiologan frame, gilded silver, rectangular plaques alternating with the narrative plaques, 14th century, 70 x 43mm

enamelling process....'.[14] The difficulty was increased by the high coefficient of the expansion and contraction of silver, which could be 'partially mitigated by the use of relatively small fields of colour',[15] exactly as it happens on the Genoa enamelled plaques. The overcoming of technical impediments related to the likely employment of glass mosaic tesserae and the melting point of the silver underlines the mastery of the artisan responsible for the Genoa frame, where the enamels are extremely peculiar, being laid in tiny grooves in embossed, gilt silver plaques. This is why it appears surprising that, with regard to the Genoa enamels, Paul Hetherington wrote that 'the creator of these reliefs was not really an enameller at all, but an artist in repoussé who embarked on this commission, for which an element of enamel was requested, and in the process invented a largely new technique',[16] as the technique had supposedly been lost after the Latin domination. Hetherington adds that the ten reliefs generally 'display a greatly diminished level of enamelling expertise', but contradicts this by saying that the artist of the Genoa frame had to be among the most appreciated of his time to be granted such an important commission as the precious Mandylion frame. Hetherington's opinion openly contrasts the technical observations made above, which instead tend to argue in favour of a great control of the enamelling on the repoussé work, clearly attesting to the ability of the artist of the Genoa frame to skillfully handle his work, as noted also by Glenn Peers: 'the importance of the commission and the complexity of its subjects assume self-conscious, cautious planning and presentation'.[17]

Another aspect of the Genoa frames that reveals admirable skills is the filigree that decorates the rectangular plaques alternating with the narrative plaques (**Pl. 15**), as well as the filigree of the four plates that surround Christ's 'three-pointed' face (**Pl. 16**).[18] The plates are decorated with a heart-shaped palmette pattern filigree, repeated endlessly with a hypnotic effect. The vegetal motifs, based on the palmette, seem to recall an 'idealised space', an edenic dimension well described by Bissera Pentcheva,[19] who argues that on the Genoa Mandylion's frame the 'virtuoso interlace glorified God through this metal, artfully wrought by human hands'. The verso of the plates reveal that the repoussé bosses and the small rectangular plaques, where the monogram of Christ and the reference to the Mandylion appear neatly incised, were not applied on the plates, but had instead been made by hammering the back of the metal backing-plate shared with the filigree (**Pl. 17**). This technique of using the same metal backing-plate both for filigree fields and for inscribed bosses can be admired on other revetted icons, as, for example, the Hodegetria commissioned by Constantine Akropolites and his wife in the late 13th century, now in the Tretiakov Gallery, Moscow. Further examples of this technique are the Lukasbild in the treasury of the cathedral in Freising, donated by Manuel Dishypatos who is identified with the metropolitan of Thessaloniki (1235–61) and the 14th-century Virgin and Child in St Paul's Cathedral in Liège.[20] The letters on the bosses of the Genoa filigree plates were once filled with niello, as the word Mandylion shows. The process of reading the words incised on the two bosses (I[HCOY]C X[PICTO]C) and the two small plaques (TO[N] AGION MANDHLION), from left to right and top to bottom, following the conventional way of reading inscriptions on icons, contribute in this case to reconstructing a visual and ontological identity between Christ, the prototype, and his name and his likeness

Plate 16 Four plates surrounding Christ's 'three-pointed' face, Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, Palaiologan frame, gilded silver and niello

Plate 17 Repoussé bosses with the monogram of Christ, Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa, Palaiologan frame, gilded silver and niello, diam. 24mm

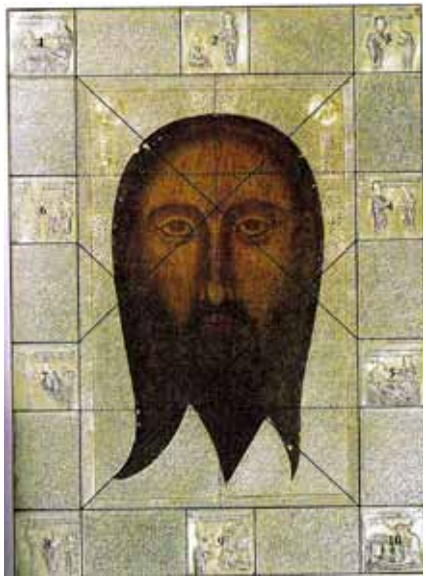


Plate 18 Hodegetria of Papadopoulina and Arianitissa, monastery of Vatopedi, Mount Athos, panel painting (a later replacement), gilded silver and enamels, 14th century

Plate 19 Diagram showing a double, intersecting visual chiasm or cross-reference among the narrative scenes, Mandylion or *Sacro Volto*, monastery of San Bartolomeo degli Armeni, Genoa

as reproduced on the Edessan cloth, i.e. the Mandylion (**Pl. 16**).

On the same plates surrounding Christ's 'three-pointed' face, the artist was also able to make with repoussé and intaglio three rectangular, convex elements with delicate openwork interlaces, whose technique probably had its origins in Islamic profane metalwork, like censers or lamps, in which the surface needed to be pierced in such a way as to let air or light to pass through (**Pl. 16**).[21] Parallels for the application of the openwork technique with Byzantine revetted icons can be found, for example, in the haloes of the Lukasbild in Freising, as well as those of the Hodegetria of Constantine Akropolites and the Hodegetria of Papadopoulina and Arianitissa in the Vatopedi monastery on Mount Athos (**Pl. 18**).

On the external frame of the Genoa Mandylion, ten rectangular filigree plaques alternating between the narrative scenes are decorated with two superimposed lines of *rotae* including three types of floral patterns, elegantly structured in a way that has been defined as 'chiastic' (**Pl. 15**).[22]

A B C

C B A

This brings to mind the chiasm, that is a 'disposition of two lines crossed like the [Greek] letter X (chi)', as well as a 'rhetorical figure, which corresponds to inverted parallelism', often to be found in Greek, biblical and general ancient literature as a mnemonic device for listeners and readers.[23] On the Genoa frame, the chiasm seems to have also dominated the dislocation of the ten narrative plaques, as reconstructed by Gerhard Wolf in a diagram with a double, intersecting visual chiasm or cross-reference (**Pl. 19**).[24] On the sides of the frame, the rectangular '*rotae* plaques' appear rotated so as to adapt their width to that of the narrative plaques (42mm), but also in such a way as to achieve an increased decorative *pikilia* or *varietas*.[25] Elements of comparisons for such *rotae* plaques, although less complicated, are to be found, for example, on the Liège icon, and on the late 14th-century micro-mosaic icon of John the Evangelist in the Lavra monastery on Mount Athos.[26]

Location of the atelier and chronology of the work

It has been noted that, while it is relatively easy to attribute to Constantinopolitan ateliers the works of definite imperial commissions, it is much more difficult to attribute works commissioned by other donors.[27] As regards to the location of the atelier responsible for the frame of the Genoa Mandylion, we can only speculate with the knowledge we have at present. However, it seems undisputable that the icon/relic was an imperial commission as demonstrated by the high quality of the craftsmanship on the one hand, and the clear message of a long-awaited political *adventus* embedded in the whole story on the other hand, a topic which I will not address on this occasion. The fact that the message embedded in the narrative of the Genoa frame is distinctly 'imperial' does not necessarily imply that the object had been manufactured in Constantinople. In fact, some distinctive features of the Genoa frame, for example the floral intaglio details, the bosses with incised, nielloed inscriptions and the filigree *rotae* plaques, find comparisons on gilt-silver revetted icons linked with Mount Athos and Thessaloniki.

As a result of the Latin occupation of Constantinople in 1204, Thessaloniki had become the new capital of the Byzantine Empire. It therefore attracted members of the imperial family, which continued when the Palaiologan dynasty was re-established on the Bosphorus when Constantinople was reconquered in 1261. In fact, its strategic geographical location allowed it easy contacts with western Europe and the Slavic world, and at the same time a relative political, social and cultural independence favoured by imperial privileges and immunities.[28] In the 13th century Thessaloniki appears as a centre of the production of icons, and, from the middle of the same century, also of revetted icons, on which repoussé is eventually combined with enamel medallions. Therefore enamel was no longer an exclusively Constantinopolitan output. A notable production of precious objects, characterized by what has been described as an 'ecumenical dimension' and a 'cultural autonomy', seems to have been established at Thessaloniki so as to satisfy demand from passing merchants, pilgrims and servicemen of Byzantine lords inhabiting the centres of

Kastoria, Ohrid, Verroia, Serres and the monastery of Mount Athos. Mount Athos preserves numerous examples of precious offerings that are clearly related to ateliers active in Thessaloniki.[29] On the basis of technical as well as stylistic elements, as well as the information given in incised inscriptions often mentioning donors, André Grabar dated a group of these revetted icons between the late 13th and early 14th century.[30] In recent studies these revetted icons have been ultimately related to Thessaloniki,[31] as for example the above-mentioned Lukasbild of Freising (which Grabar believed was Constantinopolitan because of the high quality of the craftsmanship);[32] the Hodegetria of Constantine Akropolites; and the revetment of the Hodegetria icon of Arianitissa and Papadopoulina in the Vatopedi monastery (**Pl. 18**). This latter object deserves further comments in comparison with the Genoa frame, as they both display narrative scenes in repoussé, although the Arianitissa and Papadopoulina's scenes do not have enamels on the repoussé, but rather delicate champlevé that enhances a repeated, minute lily-like vegetal motif on the lamina circumscribing the Virgin and the Child, on the bosses of her halo and in the letters of a long, dedicatory epigram. The gracious, delicate vegetal motif is part of the overall message conveyed by the Arianitissa and Papadopoulina icon, in which *charis* (grace) has been identified as the key-word: grace is in fact being recalled in the verses as an attribute of the Virgin descended on her with the Annunciation, a scene represented in the first narrative plaque in the top left corner of the frame; grace descends on Christ during the Baptism, a scene represented in the central top narrative plaque; the verses also openly express the siblings' desire to be invested by grace.[33] The Papadopoulina and Arianitissa revetment, believed to date to before 1375,[34] has been finally dated to before 1326 on the basis of the correct identification of Arianitissa as the daughter of a wealthy provincial aristocrat of Verroia, the *skouterios* Theodore Sarantenos, who lived in the first quarter of the 14th century.[35] The two sisters donated the revetted icon to the family's monastery of Prodromos at Verroia, which later became a dependence of Vatopedi. Stylistic comparisons traced between Genoa's frame, the Passion reliquary of Siena (**Pl. 9**) and the Arianitissa and Papadopoulina revetment led Paul Hetherington to date in one instance the Genoa frame to the years 1335–45;[36] although he later stated a preference for the third quarter of the 14th century, linking the Genoa date to that of the Arianitissa and Papadopoulina revetment,[37] which he believed to be related to a certain Arianitissa of the imperial family of Dukas last documented around 1375. Notwithstanding the loss of other comparatives, the Papadopoulina and Arianitissa revetment, dated with certainty before 1326, indeed appears to be a very important precedent of the Genoa frame for the selective application of enamels, although technically different; its narrative repoussé plaques; the expression of the wish of the donors to be invested by divine grace, which seems to also be the wish implicit in the story represented on the Genoa frame, culminating with the last scene in which an imperial advent is forecast. Although the Vatopedi icon revetment is of an indisputable high quality, the Genoa frame seems to reach extraordinary heights in terms of the ingenious, masterful employment of various techniques, narrative solutions and combination of the genres of the *Vita*-icons and the 'decorated icons'.

Narrative plaques in repoussé are also to be found on other revetments, as on the silver-gilt bookbinding of cod. gr. I,53 in the Biblioteca Marciana, Venice (**Pl. 6**), alternating with plaques adorned with a floral background in champlevé enamel and central medallions with busts of saints in cloisonné. This revetment had indeed been taken into account in earlier studies with regard to the Palaiologan frame of the Genoa Mandylion.[38] Another example of bookbinding in the Biblioteca Marciana in Venice, the cod. gr. I,55 (**Pl. 7**), has also been compared with the Genoa frame. Hetherington believes the comparisons with both Marciana covers offer 'the most convincing arguments to date for the origins of the artistic personality behind the creation of the Genoa reliefs'.[39] In the case of the cod. gr. I,55, the repoussé plaques show busts of saints alternating with geometric interlaces, as on other late 13th- to early 14th-century revetted icons. However, on close observation neither of the two bookbindings seems closely comparable to the Genoa frame in terms of the style of the repoussé, the technique of the enamels or the combination of the various decorative techniques.[40]

The combination of repoussé, champlevé enamel and filigree made with very thin metal strips forming stylized floral compositions on a gilt-silver backing-plate characterizes a second group of icons from Thessaloniki to be dated between the late 14th and the early 15th century on the basis of inscriptions and historical data. The city's ateliers apparently continued to produce high-quality icons until the early 15th century, as exemplified by the late 14th century micro-mosaic icon of St Demetrios donated by the Greek Cardinal Bessarione to Niccolò Perotti, Bishop of Sassoferrato in the Adriatic province of Ancona.[41]

The Genoa frame appears closer to earlier Thessaloniki revetted icons as regards to the floral openwork details and the repoussé bosses with incised, nielloed inscriptions, while the combination of filigree, repoussé narrative plaques and enamels makes the Genoa frame appear more like later icons. Therefore the Genoa Mandylion frame seems to be a transitional piece with regards to its technical evolution between the earlier (late 13th to early 14th century) and the later (late 14th to early 15th century) group, and as a consequence it could possibly be dated to the 1330s–40s. The suggestion that this was a transitional, experimental, unique piece for a special commission could be confirmed by the fact that on the frame, the enamel has been made in an unusual fashion, which cannot be placed in the attested categories of cloisonné or champlevé.

Conclusion

The Genoa Mandylion, an object likely to have been manufactured at or for the imperial court – be it in Constantinople or somewhere else – with the intention of being not simply a sumptuous, but rather an extraordinary gift enveloping the reproduction of the extraordinary *acheiropoieiton* from Edessa, had been the occasion for an inventive artisan to experiment with a new and extraordinary enamelling technique. The extreme subtlety

of the enamel work in the draperies, architectural details and so forth, combined with the finest *all'antica* chiselled faces evoking the classical taste of a certain art form during the era of Constantine VII as well as the intricate filigree patterns made the Genoa Mandylion a unique masterpiece. However, the lack of written historical documentation should discourage any attempt to create a *corpus* of works to be attributed to the unknown artist of the Genoa frame.[42] The comparisons already drawn with revetted icons executed in the region of Thessaloniki have led scholars to believe that this might have been the place of manufacture of the Genoa frame in the 1330s–40s. The historical setting of this commission needs still to be clarified.

Acknowledgements

I wish to thank for their useful suggestions and patient advice: Tassos Antonaras, Tony Cutler, Ivan Drpic, Ian Freestone, Liz James, Bissera Pentcheva, Alice-Mary Talbot, Natalia Teteriatnikov, Maria Vassilaki and Gerhard Wolf. Warm gratitude for the collaboration experienced during the project 'The Composition of Byzantine Glass Mosaic Tesserae' financed by the Leverhulme Trust goes to Liz James and Bente Bjørnholt.

Notes

1 *Cf.* B.V. Pentcheva, *The Sensual Icon. Space, Ritual, and the Senses in Byzantium*, University Park, PA, 2010, 1ff.

2 D. Buckton, 'Byzantine enamel in the West', *Byzantinische Forschungen* 13 (1988), 235–44; D. Buckton, '"Early Byzantine" enamel in France', in P. Armstrong (ed.), *Ritual and Art: Byzantine Essays for Christopher Walter*, London, 2006, 94–105.

3 A. Cutler, 'Gifts and gift exchange as aspects of the Byzantine, Arab, and related economies', *Dumbarton Oaks Papers* 55 (2001), 247–78; A. Cutler, 'Vita sociale degli oggetti', in E. Castelnuovo and G. Sergi (eds), *Arti e Storia nel Medioevo III. Del vedere: pubblici, forme e funzioni*, Turin, 2004, 291–339.

4 C. Dufour Bozzo, *Il 'sacro volto' di Genova* (Monografie I, Istituto Nazionale d'Archeologia e Storia dell'Arte), Rome, 1974, 29; A. Grabar, *Les revêtements en or et en argent des icônes byzantines du Moyen Âge* (Biblioteca dell'Istituto Ellenico di Venezia n. 7), Venice, 1975, 14; A. Loverdou-Tsigarida, 'Les oeuvres des arts mineurs comme expression des relations du Mont Athos avec l'aristocratie ecclésiastique et politique de Byzance', in *Pré-actes. XXe Congrès International des Études Byzantines*, Paris, 2001, 132–7; P. Hetherington, 'La cornice e il rivestimento del Mandylion', in G. Wolf *et al.* (eds), *Mandylion. Intorno al Sacro Volto da Bisanzio a Genova* (exh. cat., Genoa), Milan, 2004, 162; F. Dell'Acqua, 'La legatura del Cod. Gr. I,53 della Biblioteca Nazionale Marciana. Confronti tecnico-stilistici con la cornice paleologa del Mandylion e altri oggetti affini', in Wolf *et al.*, 175–89.

5 C. Bertelli, 'Storia e vicende dell'immagine Edessena', *Paragone* 217 (1968), 22; Grabar (n. 4), 3 and 14; Dell'Acqua (n. 4), 184–6.

6 G. Wolf, 'Vom Scheitern eines Porträtisten: Überlegungen zur künstlerischen Inszenierung des Mandylion von Genua und zum Begriff der "historia" zwischen Ost und West', in H. Locher and P. J. Schneemann (eds), *Grammatik der Kunstgeschichte: Sprachproblem und Regelwerk im "Bild-Diskurs"*, Zurich, 2008, 225–38, esp. 230 speaks of 'prominentia'.

7 *Cf.* B.V. Pentcheva, 'The performative icon', *The Art Bulletin* 88 (2006), 631–55, esp. 640.

8 *Cf.* Dell'Acqua (n. 4), 189, n. 11.

9 I.C. Freestone, C.P. Stapleton and V. Rigby, 'The production of red glass and enamel in the Late Iron Age, Roman and Byzantine periods', in C. Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton*, Oxford, 2003, 142–54, esp. 142ff.

10 I.C. Freestone, 'Composition and origins of glasses from Romanesque champlevé enamels', in N. Stratford, *Catalogue of Medieval Enamels in the British Museum, vol. II, Northern Romanesque Enamels*, London, 1993, 37–45; Dell'Acqua (n. 4), 189.

11 J. Durand, entry 'Smalto-Area Bizantina', in *Enciclopedia dell'Arte Medievale*, vol. X, Rome, 1999, 745–59, esp. 750.

12 I.C. Freestone, S.G.E. Bowman and C. P. Stapleton, 'Composition and origins of Byzantine and early medieval enamel glasses', in D. Buckton, *Catalogue of Medieval Enamels in the British Museum, vol. I*, London, forthcoming.

13 Wolf *et al.* (n. 4).

14 Freestone, Bowman and Stapleton (n. 12).

15 Ibid.

16 P. Hetherington, 'The frame of the Sacro Volto Icon in S. Bartolomeo degli Armeni, Genoa: the reliefs and the artist', *Cahiers archéologiques* 50 (2002), 175–84, esp. 178ff.; P. Hetherington (n. 4), 161–3.

17 G. Peers, *Sacred Shock: Framing Visual Experience in Byzantium*, University Park, PA, 2004, 129.

18 F. Dell'Acqua, 'Le quattro lamine di rivestimento in filigrana', in Wolf *et al.* (n. 4), 157–60.

19 B. V. Pentcheva, 'Epigrams on icons', in L. James (ed.), *Art and Text in Byzantine Culture*, Cambridge, 2007, 120–38, esp. 129ff.

20 Grabar (n. 4), 41–3, 63–5; A.-M. Talbot, 'Epigrams in context: metrical inscriptions on art and architecture of the Palaiologan era', *Dumbarton Oaks Papers* 53 (1999), 75–90, esp. 82–3; K. Loverdou-Tsigarida, 'Thessalonique, centre de production d'objets d'arts au XIVe siècle', *Dumbarton Oaks Papers* 57 (2003) (Symposium on Late Byzantine Thessaloniki), 241–54, esp. 247ff.

21 A. Grabar, 'Legature bizantine del Medioevo', in H.R. Hahnloser (ed.), *Il tesoro di San Marco. vol. 2, Il tesoro e il museo*, Florence, 1971, 43–54, esp. 45.

22 Bertelli (n. 5), 20.

23 N. Isar, 'Undoing forgetfulness: chiasmus of poetical mind – a cultural paradigm of archetypal imagination', *Europe's Journal of Psychology* I/3 (2005): http://www.ejop.org/archives/2005/08/undoing_forgetf_1.html.

24 G. Wolf, 'Il Volto che viaggia: premessa a un incontro', in Wolf *et al.* (n. 4), 7–24, esp. 13, fig. 4.

25 *Cf.* Pentcheva (n. 1), 139ff.

26 Bertelli (n. 5), 3–33, fig. 12; A. Bank, 'L'argenterie byzantine des Xe-XVe siècles. Classification des monuments et méthodes de recherches', in *Corsi di Cultura sull'Arte Ravennate e Bizantina, Ravenna 8–21 Marzo 1970*, Ravenna, 1970, 335–53, esp. 349; Loverdou-Tsigarida (n. 20), 251; Dell'Acqua (n. 18), 160.

27 Loverdou-Tsigarida (n. 4), 137.

28 J.W. Barker, 'Late Byzantine Thessaloniki: a second city's challenges and responses', *Dumbarton Oaks Papers* 57 (2003) (Symposium on Late Byzantine Thessaloniki), 5–33.

29 *Le Mont Athos et l'Empire byzantin. Trésors de la Sainte Montagne* (exh. cat., Paris), Paris, 2009.

30 Grabar (n. 4).

31 Loverdou-Tsigarida (n. 4); Loverdou-Tsigarida (n. 20).

32 Grabar (n. 4), 41–3, nr. 16.

33 *Cf.* Pentcheva (n. 19), 124; A. Rhoby and W. Hörandner, 'Beobachtungen zu zwei inschriftlich erhaltenen Epigrammen', *Byzantinische Zeitschrift* 100/1 (2007), I, 157–67, esp. 157–62.

34 Hetherington (n. 4), 163.

35 Rhoby and Hörandner (n. 33), 161.

36 Hetherington (n. 16), 176ff.

37 Hetherington (n. 4).

38 Dufour Bozzo (n. 4), 29, n. 25; Hetherington (n. 16), 175ff.

39 Hetherington (n. 16), 176.

40 Dell'Acqua (n. 4), 175–89.

41 Loverdou-Tsigarida (n. 20), 246ff.

42 *Cf.* Dell'Acqua (n. 4), 188.

Chapter 23
Viewing the Mosaics of the Monasteries of Hosios Loukas, Daphni and the Church of Santa Maria Assunta, Torcello

Robin Cormack

Doubts whether the mosaics in the monastery church at Daphni outside Athens are in their original state and so might be less than authentic have long been an obstacle in the art-historical study of the building. However the current technical investigations of the mosaics and consolidation of the church by the Greek Archaeological Service, which has been systematically carried out since the earthquake of 1999, will rectify this. This work should finally put an end to the hesitancies expressed in the literature as a response to the survey of Ernst Diez and Otto Demus published in 1931, which published some of the Gabriel Millet archive of photographs taken before the 19th-century restoration as well as others taken afterwards.[1] Meanwhile, in 2008 I set out some observations about the condition of the mosaic representation of Christ in the central dome at Daphni, and questioned how much or how little of the present mosaic surface in that part of the church was altered by restorers in the late 19th century.[2] The key evidence used for this discussion was a fine black and white photograph in the archive of the British School at Athens taken in the late 19th century at a time immediately before the church underwent the radical rebuilding and restoration to remedy the consequences of a series of destructive earthquakes (**Pl. 1**). The conclusion reached was that the present mosaic, contrary to some powerful assertions over the years, had changed very little from the original: there were only some relatively small patches of loss in the figure that were restored with new tesserae and that these changes were faithful to the original design. The same is clearly not true, however, of a number of other mosaics in the church, which

Plate 1 Christ Pantocrator, monastery at Daphni. Photograph by R. Weir Schultz and S. Barnsley

Plate 2 Doubting of Thomas, mosaic, narthex, church of Hosios Loukas, Phocis

did indeed have a more intrusive and distorting treatment when it was decided in the late 19th century to patch the numerous areas of loss. I want to return to this question of how far we can still appreciate the original decoration at Daphni, and cover here more extensively some possible resolutions to the date and condition of the present mosaics of the whole of the monument.[3]

The mosaics at Daphni are prominently, and surely correctly, featured in any survey of Byzantine art. Yet this recognition of their quality and importance is made despite the misfortune that virtually no historical documentation has been preserved about the date and circumstances of their manufacture.[4] There is a consensus that they belong somewhere in the period between 1050 and 1150 and that the architects and mosaicists knew and were profoundly influenced by the structure and decoration of the katholikon of the monastery of Hosios Loukas at Phocis, which is equally undated by clear historical documentation, but fits archaeologically between roughly 1000 and 1050.[5] However the style and visual impact of the mosaics at Daphni has been reckoned to differ radically from the decoration of that earlier monument in conspicuous ways. Whereas the power of the Hosios Loukas mosaics can be seen to lie in the manner of their representation in a direct, even stark, manner of the key events in the life of Christ as celebrated in the main church festivals and their focus on the essentials of the iconography, the mosaics of Daphni in comparison treat the same core subjects in more of a narrative and discursive mode, and the decoration included a set of scenes about the infancy of Christ and the life of the Virgin Mary.

This paper, like much of the literature on the decoration of the two monuments, is concerned with these stylistic features and their historical context. But it also recognizes that analysis of style without an examination of the technical information about their manufacture is incomplete. Treated together, these two elements of the decoration seem to point to a fairly exact chronology of the mosaics of both monuments, which will be the focus of this paper.

Let us start with Hosios Loukas. The surviving text of the *Life* of the patron saint, St Luke of Stiris, combined with the archaeological and architectural evidence helps to give a framework of the history and development of the site in the 10th and 11th centuries. The saint was born in AD 896 and moved to the present location of the monastic settlement in AD 946/7 where he remained until his death in AD 953. It emerges from the examination of the fabric that the Panagia church was earlier in date than the katholikon (some of the external wall of its outer narthex formed part of the northern side of the church, and a fragment of a painting of Joshua, originally painted on the east wall of the southern chamber of the outer narthex, was found beneath the marble revetment of the katholikon), and it was built closer to the hillside, before the foundations of the katholikon were put down.[6] In due course the area to the south of that first church was developed, and the present katholikon and the mortuary crypt below it were built and decorated with a combination of mosaics and wall paintings.

The most disputed date for the understanding of the site is that of the katholikon and its decoration (**Pl. 2**). Prior to two challenging articles by Manolis Chatzidakis (1909–98) in 1969 and 1972, an early 11th century date was predominantly canvassed in the modern literature on the basis of stylistic considerations.[7] For example there was the suggestion that the mosaics were an imperial donation, and that an appropriate candidate was Basil II (AD 976–1025) after the end of the Bulgarian war in 1017–18 when he passed through this region in 1018 on the way to worship at the Parthenon, the cathedral in Athens.[8] It is not difficult to suppose that the emperor's itinerary took him to visit the burgeoning monastery of Hosios Loukas. However, in circulation were two differing oral traditions reported by Kremos (in 1874–80): firstly, that Cyriacus of Ancona who visited the monastery in 1436 had attributed the foundation of the monastery to Emperor Constantine IX Monomachos (1042–55), and secondly that the monks told Jacob Spon and George Wheler (1676) that the founder was Emperor Romanos II (AD 959–63). Manolis Chatzidakis, however, changed the discussion. He believed he had found the final solution to the problem, on the grounds that the medieval text about the translation of the relics of the saint into the katholikon gave a precise date, and that this event must have occurred when the structure was complete. He interpreted this text of the *Akolouthia* (The Rite) of the *Anakomidi* (Translation of the Relics) to give the date of 3 May in either

1011 or 1022 for the inauguration of the church.[9] He is less precise about the dating of the mosaics and wall paintings in the 11th century, except to agree with the opinion that they were coeval. Nano Chatzidakis in her 1996 study accepted his interpretation of this document and argued that the more probable date of the two was 1011.[10] She concluded on the basis of this text that the translation of the relics into the katholikon as well as its mosaic decoration was carried out under the control of Abbot Philotheos, whose name is mentioned in the *Akolouthia* and whose portrait is found in the crypt wall paintings and probably in the north-east chamber of the katholikon in which he is offering a model of the church to St Luke. In her 1982 publication of the wall paintings in the side chapels of the katholikon, Chatzidakis had attributed this section of the work to the abbot Theodore Leobachos between 1035 and 1055.[11] She reconciled this evidence in 1996 by treating 1011 or even 1022 as valid dates for the completion of the structure of the katholikon and assuming that the mosaics and wall paintings were planned as a unit, which may have taken up to 30 years to complete, giving a time of either up to 1041 or 1052 for the activity of the workshop in the monastery. Carolyn Connor had also agreed in 1991 that the mosaicists and the fresco painters of the katholikon and the crypt were the same and that both the katholikon and the crypt date from the same campaign. However, Connor argued that the katholikon dated between AD 956 and 970, and was decorated through the sponsorship of abbots Philotheos and Leobachos between AD 970 and 1000.[12] All the other literature has treated the representation of St Nikon the Metanoeite in the mosaics as an indication that they must date after his death in around 1000. Doula Mouriki had already argued the contemporaneity of mosaics and wall painting at Hosios Loukas in 1980/1 and 1985. She concluded on the basis of documentary evidence that the mosaics of Nea Moni on Chios were produced for Emperor Constantine IX Monomachos between July 1049 and his death on 11 January 1055, but that the dating of Hosios Loukas depended primarily on style. However, she was influenced by the idea that the work was done under the patronage of Theodore Leobachos, whose period as abbot she placed in the 1040s or even the 1030s. Accordingly she dated the decoration of Hosios Loukas to the 1030s, noting that in her view they looked stylistically earlier than the related mosaics of St Sophia at Kiev, a church begun according to Lazarev in around 1037 and completed between 1042 and 1046.[13] The relative dating of these two decorations is far from established, however. They are certainly very close in date, as a comparison with the orant Virgin in the narthex of Hosios Loukas with the Virgin in the apse in St Sophia indicates. But this does not exclude the possibility, in my opinion, that the mosaics of Kiev are earlier than Hosios Loukas.

The reason why stylistic analysis has remained the method for most, but not all, researchers to date the decorations of Hosios Loukas despite the conclusions of Manolis Chatzidakis in 1969 and 1972 is that his precise interpretation of the liturgical manuscript was instantly challenged. According to Cyril Mango, where Chatzidakis saw a specific indication of a historical event in the text, the wording was actually generic: in other words that the festival of the translation of the saint's relic on 3 May will fall on the festival day of the Ascension of Christ in any year when Easter falls on 25 March. It does not mean that it did fall on that day in the year when the translation first occurred.[14] It follows, if this critique is correct, that we do not know the exact year of the completion of the katholikon or the sequence of its mosaics and wall paintings from this text.

A review of the documents and other evidence was undertaken by Nicolas Oikonomides in 1992.[15] This resolves a number of the issues and sets out a hypothesis for the dating of the katholikon and its decoration. He did accept that the translation of the relics of St Luke were transferred into the newly built katholikon in 1011, and that it does record a historical moment since the canticle speaks of the 'invasions of the Scythians' which Oikonomides takes to mean the Bulgarians under Samuel (AD 997–1014). Oikonomides does not, however, mention the objection by Mango to such a concise use of this text.

Oikonomides believed that the decoration of the katholikon was the work of four consecutive 11th-century abbots, Luke (*d.* 1005), Philotheos (*fl.* 1011), Athanasios and Theodosios, (*fl.* 1048), who are all represented in portrait medallions in the south eastern groin vault of the crypt. Oikonomides suggested that they financed the works from their family connections in Thebes.[16] He records and analyses the inscription on the coffin of a monk Theodosios, previously called Theodore, and argues that it was the tomb of Theodosios Leobachos. It can be deduced from the *Typikon* of the religious confraternity created in 1048 in Thebes of the cult of the icon of the Virgin Mary Naupaktitissa that he was abbot of the monastery in 1048.[17] Oikonomides' conclusion is that the mosaic decoration was done by Theodosios, once an imperial official, with the support of Emperor Constantine Monomachos in the 1040s and that the wall paintings of the crypt were finished soon after his death, perhaps immediately after 1048, since his portrait is included in the programme. The purpose of the crypt, which once housed the tomb of Hosios Loukas, was to act as a mortuary chapel. The marble decoration of the katholikon is recorded in an inscription as the contribution of Abbot Gregory, perhaps the next abbot after Theodosios, and the man who completed the decoration of the katholikon in this period. The difficulty in this outline is that it accepts that Philotheos was involved with the architecture of the katholikon, but the whole process of decoration took several decades to complete. This means that the grandeur of the church structure and its sculptural decoration implies equally monumental decoration to match, yet this took years to complete. However, there are parallels: on a small scale this is how several of the rock-cut churches of Cappadocia were developed, first with a decoration of repeated crosses, and then later fully painted thanks to sponsorship. The church of Torcello equally took several decades before it received its mosaic decoration. So seeing this as the pattern of development at Hosios Loukas may be supported from the evidence of other cases. No doubt the often quoted speed in which Justinian's Hagia Sophia at Constantinople was built was the exception rather than the norm.

In sum the dating of the mosaics and paintings to the 1040s fits very well with their stylistic connections, and is a

compelling conclusion. It does not rest on the 1011 or 1022 proposition. While it is not necessary to assume the co-operation of Constantine Monomachos in the provision of mosaics, most likely the mosaicists did in fact come ultimately from Constantinople; it is hard to believe they were from a local workshop in Thebes or even Thessaloniki (where the 11th-century Virgin and Child in the apse of Hagia Sophia was very likely the product of local artists).[18] More needs to be said on the connections of the wall paintings and the mosaics, for this has further implications for the dating. The issue that requires explanation is the fact that there are certain striking stylistic differences between them. Essentially this lies in the bold and stark character of the mosaics compared with the more narrative and emotive manner of the crypt paintings, with the insertion of details which enhance the narrative of the scenes. These differences are most clearly seen if a comparison is made of the two portrayals of the Doubting of Thomas in the church, one in the narthex (**Pl. 2**) and one in the crypt below (**Pl. 3**).

The mosaic version was placed in the south conch of the narthex, and is now disfigured at the centre by the window opening.[19] The face of Thomas is lost (and some of the mosaic around him was remade in the modern restoration by Eustathios Stikas). The panel remains a striking image of the event described in the Gospel of St John (20: 26–9) when the doors were locked and Jesus appeared to the disciples in order to show himself to Thomas after the Crucifixion, who put his finger into his side and declared himself a believer in the truth of the resurrection. The panel is entitled in Greek: 'the doors were locked' and the inscription is fitted in tightly above the doorway. Both the background and framing of the door are represented with gold tesserae. Christ raises his arm high to expose the wound in his chest towards which Thomas moves his finger. To the left of the bending figure of Thomas are five of the disciples, who all gaze at the wound of Christ. Similarly the five disciples on the right side gaze into the same point.

The composition of the wall painting in the crypt below has several similar features, such as the gold highlighting of the door, though in comparison the gold webbing of the mosaic is more powerful a sign than the painting, as it can be read as divine light emanating from the body of Christ. The painting has several other significant differences. The background is not plain gold, and the arrangement of the apostles is different. There are only four apostles behind Thomas, and instead there are six on the right. In both groups their gaze is diversified: one figure on the left looks away and out of the picture, as if seeing some further event, and the front figure on the right, presumably Peter, looks back at his companions, as if to judge their reactions to the event. Most significantly of all, Christ does not hold up his right hand high, revealing the nail hole in the palm of the hand as he does in the mosaic, and at the same time giving a grand gesture of acclamation. Instead in the painted version he firmly grips the hand of Thomas and guides it into the wound. He looks down at Thomas and twists his body as Thomas feels the reality of the wound. Unlike the hieratic portrayal of the event in the mosaic, the painting, which the viewer can observe from a closer perspective, communicates the human responses at the moment when Thomas accepts

Plate 3 Doubting of Thomas, wall painting in the crypt of the church of Hosios Loukas, Phocis

the truth of the resurrection. For Connor, the two panels 'depend on the same models'. But the relationship is more subtle than that. Close examination of the present surface of the wall painting reveals that there was a major *pentimento* in the course of the work.[20] The artist started to paint the right arm of Christ exactly as it was in the mosaic, which was surely his model, but then changed his mind and painted the more poignant version that we now see. Over time the original sketch plan has been revealed as the final coat of paint has become more transparent. The conclusion from this is that the mosaic was the direct 'model', but it was changed and adapted to introduce a more narrative interest in the crypt. Other panels in the crypt likewise introduce extra storylike details. A further point can be made about the different character of church and crypt decoration. If the same artists carried out the mosaics and wall paintings, it follows that a considerable variety of styles was something that they could handle as the circumstances required. The work at Hosios Loukas demonstrates that Byzantine art was not a rigid domain with 'one man, one style'. The chronological implications of the close relationship of the church and crypt is that the same workshop and artists were still working in the monastery after the death of Theodore Leobachos, who is portrayed among the saints in the crypt. That seems to suggest a finishing date after his death in or after 1048. The artists were not ready to move to a further commission until that time.

When considering the mosaics of the monastery at Daphni, three points seem relevant. The first is that here too the style of the decoration is not identical throughout, but shows all sorts of subtle differences in the representation of the figures. There seems no obvious need to assume that this means that different artists or workshops carried out the different sections of the programme, though this may be a solution for these variations. One might see the difference in the narthex as a response to the different viewing experience from the high vaults of the naos, or as the work of a different artist, or an artist whose style developed over the time that the mosaic was produced. The second point is that one might want to question how far the style is radically different from Hosios Loukas (as often claimed). Some passages of

Plate 4 Christ Pantocrator, monastery at Daphni

Plate 5 Christ Pantocrator, monastery at Daphni

mosaic are in fact very similar, though the general trend of the mosaics is towards the greater narrative interest that is shown in the wall paintings in the crypt of Hosios Loukas, which were presumably the last works to be done at the monastery. This raises the possibility that the artists of Hosios Loukas moved on to work at Daphni. Though this notion sounds to be historically far too simple, it has to be considered, as the number of artists capable of working in mosaic in Byzantium may always have been relatively few. But what does seem evident is that the mosaicists of Daphni are not likely to have been trained in Athens, but can be assumed to have arrived from some other centre.[21] The coincidence which has to be explained is why there are so many visual connections between the main festival scenes in the naos of Daphni and Hosios Loukas. The third point is that the dedication of the katholikon was surely to Mary, Mother of God, and this influenced the choice of scenes throughout (from the unexpected scene of the Birth of the Virgin in the naos to the infancy cycle in the narthex). The dedication of the katholikon of Hosios Loukas was different, perhaps, it has been suggested, even to St Luke of Stiris himself.

In looking at the decoration of Daphni I would like to frame the questions through the eyes of the person who introduced the mosaics to me as a student in London in the 1960s. Hugo Buchthal (1909–96) was at that time based at the Warburg Institute. He never published his Daphni lecture in full, though it became part of his annual Courtauld lecture course, and a résumé was published on the occasion of its first delivery in Berlin on 23 May 1958 (in German).[22] The highpoint of the lecture was to show a black and white slide of Christ in the dome at Daphni that emphatically represented the severity of the Pantocrator of the Last Judgement (**Pl. 4**). Buchthal then projected a second slide which showed the dome image of Christ again, but looking substantially different and more benign (**Pl. 5**). His conclusion was that the first slide, which showed the mosaic before its 19th-century restoration, and the second slide, which showed the mosaic in its 1950s state, were conclusive evidence that the dome Christ at Daphni was completely reset during the 19th-century restoration, and had totally lost its original appearance and Byzantine visual presence. The black and white image photograph used by Hugo Buchthal was filed in the Warburg slide collection, and some years later I copied it and it entered into the Courtauld collection as well. I too showed this slide in my lectures at the Courtauld as well as at a centenary lecture at the British School at Athens in 1986, referring to Buchthal's opinion. The publication by Diez and Demus in their 1931 survey of photographs from the Gabriel Millet archive had already documented and publicized the state of some of the mosaics before and after the 19th-century restorations; they chose examples where it could be seen that gaps in the mosaics were reset with new tesserae during the restoration.[23] Their publication means that it is a well-known fact that after the earthquake damage of 10 January 1889, something radical happened to the mosaics of Daphni. To emphasize the situation they dedicated their book to Gabriel Millet and recorded their debt to his 1899 monograph and his lectures in the USA in 1927. The facts are, however, more difficult to retrieve from the literature, although Millet set out some information on the work of the 19th century. It was the aim of my paper of 2008 to add to this material, but the research of Eleni-Anna Chlepa (2011) into the Greek archives of the period allows greater precision.

The sequence of known interventions at Daphni might be said to begin with the visit of Pyotr Sevastianov in the 1860s, who washed some of the mosaics and made copies and photographs when it was still in use as a church.[24] From 1883 the building functioned as a hospital. Rain infiltration in the winter of 1885 damaged the Pantocrator (a piece of mosaic fell) and the apse Virgin. At some time after 12 July 1885, Francesco Novo came from Venice and carried out some repairs. On 16 (27) August 1886 a serious earthquake caused more damage and remedial work to the structure began in 1888 which in due course involved the removal of the bell tower and the repair of the dome. Then came another major earthquake on 10 January 1889, with serious damage to the dome and other mosaics. In March 1889 Professor Carlo Novelli arrived from Ravenna to advise, and on 1 April 1889 wrote a memorandum to the Minister of Culture with recommendations for the mosaic restoration. This report argued that the mosaics, particularly those of the dome which were in danger of falling, should be consolidated by

Plate 6 Christ Pantocrator, monastery at Daphni, after Gabriel Millet (1899)

fixing them to the masonry with clamps and cement ('con grappe e cemento').[25] This expedient was put into practice, although by 11 May there was a counterproposal that the mosaics should all be detached from the building and displayed in a museum. Novelli carried out temporary repairs to the mosaics before he was obliged to return to his commitments at Ravenna (his departure recorded in a document of 27 November 1889).[26] The next action was taken from September to December 1890 when two restorers from the Salviati workshop (Arturo Ambrosi and Giuseppe Zambon) came from Venice and took down the mosaics (the sutures of the square sections in which the gold ground was taken down were visible to the eye when the mosaics were later replaced). The dome was remade and rebuilt in the summer of 1891. In August 1892 Salviati sent Francesco Novo and Giuseppe Zambon to re-insert the mosaics in the church. They were instructed (in October 1892) not to fill in the lacunae, but to mask them with a neutral colour. The work proceeded, but in April 1894, a new earthquake caused the vault of the narthex to collapse. The architect of the French School at Athens, Eugène Troump, was commissioned and he reconstructed the narthex, the western vault of the church and the north-west chapel. He also uncovered during this work the narthex mosaics of the Prayer of Joachim and Anna and the Betrayal of Judas. Francesco Novo worked at Daphni until 1897 when he returned to Venice. Although initially he was asked to consolidate the mosaics without making good the losses, he was subsequently asked to make the restorations that we see now, apparently between 1895, when the mosaics had been replaced, and 1897.[27] It was this period of significant remodelling of the damaged panels that changed the interior of the church and the viewer's experience. Other excavations took place around the church in September 1897. Further work was done by the archaeological service in the building in 1906, 1917, 1959 and the 1980s.

To return now to Buchthal's lecture on the mosaics of Daphni, his approach owed more to the observations of Diez and Demus (1931) than to those of Gabriel Millet (1899), though he used both sources. Millet covered in Part I of his book the history and architecture of the monastery, and then turned in Part II to the mosaics. It becomes increasingly clear that the aim and logic of Part II is to find a series of comparisons as a method of dating the mosaics. With dating in mind he looked first at the context of the ornament in relation to other Middle Byzantine decorations and then followed this up with a description of the programme in order to contextualize the iconography with other monuments, moving on to pictorial perspective, the figure style and gestures, the drapery style, the modelling of the figures, the character of the compositions and finally the technique and colours. This all leads to the reasoned conclusion that the mosaics date to the second half of the 11th century. His analysis was based in part on pre-restoration photographs, and it appears that the study of them was done in Paris rather than in the field. Millet has surprisingly little to say, for example, about the Christ in the dome or how the decoration worked as an ensemble. What he says about the Pantocrator (pp. 142–3) is that it closely resembles one of the three representations of Christ at Hosios Loukas. Millet is concerned about its date, not about its qualities as an image. For Buchthal, on the other hand, the outstanding and most independent image at Daphni was the Christ in the dome, and he specifically admired the visual power which he saw in his pre-restoration black and white photograph, but not in the colour frontispiece of Diez and Demus which represented the image after its restoration. He did not credit the source of his crucial slide. I have usually assumed that it was taken during Millet's campaign, as Buchthal was often the beneficiary of photographs from Paris, thanks to the agency of his colleague André Grabar. It represents Christ in a similar (but not identical) state as in the photograph published by Millet in 1899, and it is not taken from precisely the same spot in the naos (**Pl. 6**). The photograph may alternatively be from the collection of Josef Strzygowski (1862–1941), but this is less likely: Buchthal had as a student met and talked to Strzygowski in Vienna, but unlike the more tolerant Diez and Demus (both students of Strzygowski) he could not disengage his dislike of his politics from his assessment of his scholarship (he commented once: 'How could any intelligent scholar describe St Sophia at Constantinople as a fire-temple').[28] Both Buchthal's slide and Millet's published photograph show small patches of loss in the eyes, in the neck and at other points in the drapery and in the hands. The losses in the medallion and gold ground are slightly different and are seemingly slightly more extensive in the photograph published by Millet, which should therefore be treated as later in date. However it can be seen from the similar distortions in the arms of the cross in the nimbus that both photographs are taken from almost directly below the centre of the dome. This is not the intended Byzantine viewpoint of the figure, as the distorted cross immediately reveals. The viewing intention of the mosaic designer at Daphni has been firmly stated by an art historian who devoted much attention to the visuality of dome designs (who also attended Buchthal's lectures at the Courtauld). This was John Shearman (1931–2003) who in 1992 put the Daphni

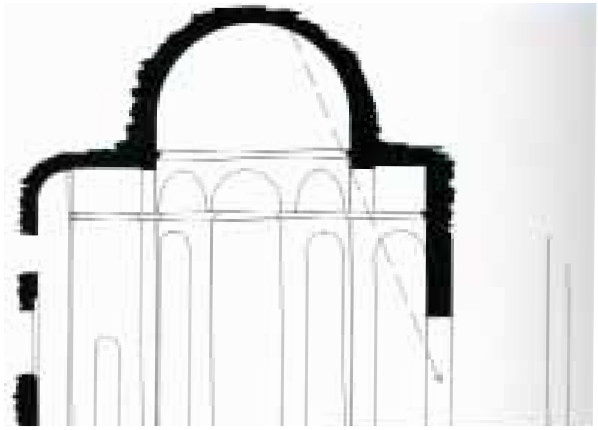


Plate 7 Cross-section showing correct position in the church for the viewing of the Pantocrator at Daphni, after John Shearman (1992)

Plate 8 Photograph showing correct viewpoint of the Pantocrator at Daphni, after John Shearman (1992)

dome into the context of Italian Renaissance strategies, and so offered a corrective insight into the viewing of Byzantine domes.[29] He argued that only a viewer who is standing under the centre of the arch from the inner narthex can understand the impressive presence of Christ Pantocrator (**Pl. 7**). He contrasts this correct viewing with the regular position adopted by many photographers who place the camera in the centre of the church directly below the dome. From that axis, Shearman argues, the mosaic figure becomes a merely an 'abstract' object. He emphasized how the Daphni image seen from its correct viewpoint is an illusionistic (or phenomenological) one, conceived and designed, as he put it, so that its meaning is part of the viewer's experience (**Pl. 8**).

Plate 9 View of the interior of Daphni by R. Weir Schultz and S. Barnsley

Buchthal's photograph, then, is taken from the 'wrong' viewpoint. Equally problematic is that since it is a two-dimensional photograph of an image on a curving surface, it inevitably distorts the features of the face of Christ. It is therefore impossible ever to see the image looking like this when viewing the mosaic in the church itself. The print is a modern technological abstraction of the face of Christ. There is however a further distortion since the photograph was not taken from directly beneath the centre of the dome. Buchthal's slide was photographed from the floor of the church, but with the camera placed in a position to avoid the impediment of a large wooden beam. This hazard is revealed by a photograph of Robert Weir Schultz and Sidney Howard Barnsley taken in the church before the earthquake (and probably in March 1888) which shows this beam under the dome (**Pl. 9**).[30] Its architectural purpose is odd (and it was removed during the restorations). Unlike the tie beams across the sanctuary which are a structural element holding the arches together, this beam seems to have little function except to act as a support for the central chandelier. It intruded into Buchthal's photograph, and cuts across the view of the mosaic. The photographer has taken a position on the floor that allowed as clear a view as possible of the dome Christ, but one which had its effect on the angle at which the face of Christ appeared. The photograph (before the earthquake) published by Millet shows no such obstruction, and is presumably therefore taken from a position higher up and not from the floor. In the light of these physical factors influencing his photographic record of Christ, Buchthal's assessment of the impact of the original Byzantine image is highly questionable. The austerity which he so much admired is no more than a photographic confection. It is not a reliable transcription of the mosaic as seen by the viewer in the church. However one of his questions remains an issue: whether in repairing and reconstituting the losses in the mosaic, the 19th-century restoration did indeed alter the surface of the mosaic, and rework the image to become a more sympathetic, if not downright sentimental, vision of Christ.

Plate 10 Detail of Plate 1

Plate 11 Christ Pantocrator, monastery at Daphni

To decide this question, another photograph in the Weir Schultz and Barnsley archive is vital, one which must have been taken from a scaffolding immediately below the mosaic of Christ, sometime in 1889, and most likely in November 1889, since Schultz's notebooks in the British School Archive (nos 12 and 13) contain a description of the Pantocrator made in the church at this time. This photograph shows the state of the mosaic soon after the 1889 earthquake, and is the clearest document for understanding what changes were eventually to happen to the mosaic of Christ during the subsequent restorations (**Pl. 1**). The photograph shows that the mosaic at this time was kept in place by a series of clamps hammered into the plaster, and that cross-shaped clamps went through the patches of loss in both eyes (**Pl. 10**). This was the remedial work recommended by Novelli in April 1889, and carried out before November 1889. These losses were made good when the mosaic was replaced in the dome, the clamps were removed, and new tesserae were inserted in the eyes where they had been lost. However these areas of remade tesserae are not large enough to change the stylistic aspect of the face of Christ, and the eyes did indeed always look away from the viewer to the right. It is in the region of the eyes that Buchthal's photograph was particularly misleading, as the pupils do look in it as if the gaze of Christ was directed frontally towards the viewer. But this was not the case. After the earthquake of February 1981, further work was done in the church, and some of the sutures visible from the removal of the mosaic in the 1890s were smoothed over, though they could still be seen in the gold ground (**Pl. 11**). In sum the changes to the face of Christ in the restoration of the 1890s made no changes to the character of the mosaic. The few tesserae that were replaced exactly imitated the colours and position of the Byzantine work. Buchthal was misled by his photograph to create in his mind's eye an image of Christ which was never there.

The visual impact of Christ in the Daphni dome was equally powerful in two other mosaics in the vaults of the church: St John the Baptist in the apse of the left side-chapel, and St Nicholas in the right side chapel. Manolis Chatzidakis made the connection between these images, concluding that 'John the Baptist was drawn with realistic intensity by the same artist who painted the Pantocrator'.[31] The face of St John the Baptist conveys exactly the same grim austerity of the dome Christ (**Pl. 12**) and the figure turns his gaze similarly away from the viewer. This mosaic confirms the character of the original style of Christ.

Buchthal's opinion of the dome Christ led him to some further conclusions, which remain provocative in outline. In his view the representation of Christ was utterly at variance with the style of the 16 prophets in the drum and of the mosaics lower down in the naos. The problem here is that he has exaggerated the differences through his confident reliance on the dome photograph. Then he argued that the mosaics of the narthex represented a further major shift in style, which he connected with the miniatures of the manuscripts in Paris and the Vatican Homilies by the monk

Plate 12 Detail of St John the Baptist, conch of left side chapel, monastery at Daphni

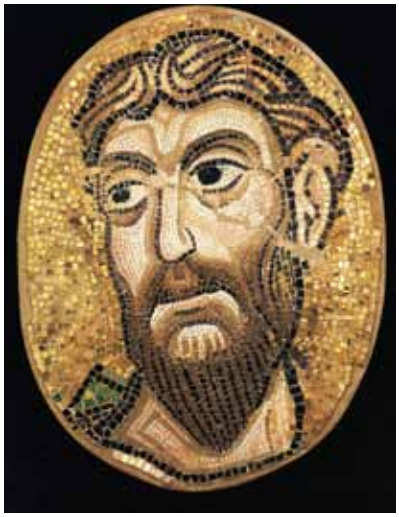


Plate 13 Detached apostle from Torcello. Private collection, New York

James Kokkinobaphos (which are currently dated by most observers to the second quarter of the 12th century, and attributed to Constantinople).[32] His conclusion was that Daphni was the work of three separate artists or workshops, and the Dome master was the most accomplished. Perhaps, Buchthal speculated, he was commissioned to produce the whole programme, but accidently fell off the scaffolding and died from his injuries, and the work had to be continued by his assistants or new workshops. This division of the mosaic work by Buchthal into three groups coincides closely with Diez and Demus (1931), though they argued that due to the modern restorations at Daphni the differences between the 'different' masters are not as great as at Hosios Loukas (where they supposed that one group of craftsmen was responsible for the naos, and a second and 'superior' group for the narthex).[33] They, like Buchthal, saw the master of the dome Christ as totally isolated in his genius from the rest of the work. The mosaics of the prophets, the scenes in the squinches, the angels in the bema, and some of the scenes on the walls (Crucifixion, Anastasis and Koimesis) belonged to the second group. The third group consisted of the other Christological scenes in the naos and all the narthex panels – which they saw as the latest to be done and 'approaching the style of the 12th century', whatever exactly that meant. Mouriki (1985) dated the mosaics of Daphni to the last quarter of the 11th century, and reckoned there was a consensus for this bracket.[34]

There is of course no way of confirming or denying these subjective interpretations of the style of the mosaics of the two churches, nor of deciding how long the decorations took to complete in each church, or how long the artists were present on site, or indeed how many artists were involved. The literature seems to assume a very slow rate of progress in carrying out the work, and that is also an opinion rather than a documented fact. Nor do we have figures on how many workers were involved in carrying out the manufacture of the tesserae, the preparation of the surfaces and the setting of the tesserae. If we were to suppose that the work at Hosios Loukas was completed in the decade of the 1040s or 1050s, then it might be possible to see the work at Daphni being undertaken as early as the 1050s or 1060s. The comparison with the manuscripts of the period of the Homilies of Kokkinobaphos may point to no more than common interests in the narrative portrayal of the Gospels and the apocryphal life of the Virgin.

A possible solution is to extend the discussion to the mosaics of the Venetian lagoon, and to consider the dating of Daphni in relation to the mosaics of the church of Santa Maria Assunta on the island of Torcello. This is of course to accept, as does Mouriki, that the mosaics of Nea Moni on Chios belong to a different, separate stylistic tradition (her terms are 'painterly' for Nea Moni and 'linear, hieratic' for Hosios Loukas). Torcello on the contrary offers many similarities with Daphni.The questions are who were the artists responsible for the first mosaics at Torcello and what was the date of their work? Diez and Demus (1931) gave them only cursory attention, but had an opinion, dating the mosaics of the apostles in the apse to the 11th century by comparison with Hosios Loukas, and dating the Virgin in the apse and the west wall of the Last Judgement to the 12th century.[35] With Demus' (1902–90) final work and statements on the mosaics of San Marco in Venice, published in 1984, and Irina Andreescu-Treadgold's studies at Torcello from 1972 onwards, the history of Torcello has become more precise, but the proposals for the chronology and connections of San Marco have become much more complex, and perhaps misleadingly firm.[36] Andreescu-Treadgold has demonstrated that the apse at Torcello as well as the west wall with the Last Judgement was decorated with mosaics during the 11th century, and then they were both repaired piecemeal after serious damage in the late 12th century. After the examination of the San Marco mosaics from scaffolding, Demus (1984) argued that the first mosaic decoration at Torcello chronologically preceded the earliest decoration of San Marco. He dated the mosaics of the niches around and above the central door of San Marco which leads from the atrium into the nave to the period after 1063, perhaps as late as the 1070s.[37] He connected their style with the apse apostles of Torcello, dating them in the 1050s. The mosaics of the main apse of San Marco he dated to around 1084, arguing they are later than Torcello and 15 to 20 years earlier than Daphni. Next in his postulated sequence were the mosaics of San Giusto at Trieste, seen as later than Daphni and by a workshop from Constantinople. The mosaicists of Torcello, in this scenario, were the first to come to Venice from the East. Their work presumably started in the apse, and there is no evidence whether the nave walls were decorated. The west wall was perhaps the final stage of the campaign, before the workshop moved on to San Marco. In sum the sequence proposed by Demus (1984) on the basis of stylistic evolution in the second half of the 11th century is as follows: Hosios Loukas, St Sophia at Kiev, Santa Maria Assunta at Torcello, San Marco, Daphni and San Giusto at Trieste. Demus does not specify to what extent the same artists were involved in any of these commissions. The sequences depend on his reasoned, but personal, visual analysis of the progression of the art of mosaic in Byzantium.

The stylistic connection between Daphni and Torcello can be approached through a mosaic that (surprisingly) appeared some years ago in Wales (**Pl. 13**).[38] This remounted detached piece was one of the heads of the apostles that were taken down from the west wall of Torcello in the 19th century, probably by the restorers of the Salviati

Plate 14 Torcello apostle before removal from St Anne's church at Talygan, Wales, 1986

Plate 15 Torcello apostle before removal from St Anne's church at Talygan, Wales, 1986

company in 1872–3.[39] By the year 1889 this mosaic medallion was installed in the then recently rebuilt church of St Anne at Talygarn in the parish of Pontyclun, Mid-Glamorgan. The sponsorship for this church came from the engineer and archaeologist, George Thomas Clark (1809–98), the owner of Talygarn House nearby, and it was intended as a memorial for his wife, Ann, who died in April 1885. In a matter of weeks after her death Clark was in Venice and his letters (now in the archives of the National Library of Wales, Aberystwyth) record several purchases of works of art during his stay.[40] Most likely the Torcello mosaic was one of his purchases at that time, but so far the record of the transaction has not been identified in this archive. It was removed from the wall of the sacristy at Talygarn by the National Museum of Wales, Cardiff, at the request of the vicar, the Reverend Martin Reynolds, in August 1986 (instantly after its identification from a photograph by Robin Cormack) and sold at Sotheby's on 9 July 1987, when it was purchased by a private collector in New York (**Pls 14**–**15** for its position before removal). The head seems best identified as either St Bartholomew or St James the Greater, and despite its removal from the Last Judgement composition at Torcello, and subsequent history, it offers good evidence for the original mosaics of the 11th century. Examination of the tesserae by Andreescu-Treadgold (1997) in comparison with other Torcello mosaics confirmed that the face is substantially from the 11th century, with some 12th-century repairs as well as some 19th-century cosmetic replacements of tesserae. With this knowledge of its condition, the apostle's face can be carefully used as one piece of evidence for a comparison of the mosaic practices and style at Torcello in the 1070s with the decorations at Daphni. Other detached pieces of the medieval mosaic from the west wall can also be brought into play, such the faces of angels which are now preserved at Sèvres, in the Louvre (**Pl. 16**) and in the Torcello Museum.[41]

The comparison of the Torcello head with Daphni offers stylistic connections both with the St John Baptist in the side apse and the narthex cycles of the infancy of the Virgin and life of Christ at Daphni. Of course one has to take into account the restorations of Francesco Novo but thanks to Millet's archival photographs the nature of his work can be detected.[42] The comparison of the Torcello apostle with the face of Christ (despite some remaking in the hair) in the Betrayal of Judas in the narthex (**Pl. 17**) underlines the use of the same colour range in both decorations, predominantly hues of brown, pink and white, and the same modelling of the eyes (with large black glass tesserae for the pupils) and eyebrows, and the sweep of the shadowing of the nose up

Plate 16 Detached mosaic of angel from Torcello, Musée du Louvre, Paris (Inv. no. OA 6460)

Plate 17 Detail of Christ from the Betrayal by Judas scene, narthex, monastery at Daphni

Plate 18 Detail of angel from the Presentation of the Virgin scene, narthex, monastery at Daphni

into the eyebrows. A similar modelling where the shadow of the nose continues up into the eyebrow is found in the Louvre angel and the angels in the Presentation of the Virgin (**Pl. 18**). Another connection between the angels is the modelling of the chin and the range of colours, with a predominance of dark red and black in the hair. Again the Torcello apostle has significant links with the modelling of the features of the St John the Baptist mosaic (such as the outlining of the nose and the modelling of the forehead). In other words the west wall of Torcello has parallels with both the earliest and the latest mosaics at Daphni. The connections between the apostles of the main apse at Torcello and several figures at Hosios Loukas demonstrate that the three decorations are all linked together in their treatment of mosaic.[43]

It has become only too obvious that stylistic analysis has led to several incompatible results in dating the 11th-century mosaic sequences. This paper suggests that one should seriously consider whether in the mosaics of Hosios Loukas, Daphni and Torcello we might be able to isolate the traditions of one workshop over a generation or two, with the possibility that Daphni and Torcello are not only close in date, but that Torcello was the next commission after Daphni. But such a suggestion requires further evidence. The question is whether analysis of the production and composition of the glass tesserae in these mosaics might point in the same direction.

Notes

1 E. Diez and O. Demus, *Byzantine Mosaics in Greece: Hosios Lucas and Daphni*, Cambridge (Mass.), 1931. G. Millet, *Le Monastère de Daphni. Histoire, Architecture, Mosaiques*, Paris, 1899, gives (pp. ix-xi) an account of the restorations from his knowledge. Millet himself started to work on the monograph in 1892. Up to pages 69 were printed in the spring of 1898, and the second part finished after a year's illness in 1899.

2 R. Cormack, 'Rediscovering the Christ Pantocrator at Daphni', *Journal of the Warburg and Courtauld Institutes* 71 (2008), 55–74.

3 The important recent publication is E.-A. Chlepa, *Byzantine Monuments in Modern Greece. Theory and Practice of the Restorations 1833–1939* (in Greek), Athens, 2011. The coverage of Daphni (pp. 76–102) usefully supplements previous accounts from her study of the Greek 19th-century documentation, including the accounts and discussion of the *Ephoreia*.

4 See, in addition to Gabriel Millet, R. Janin, *Les églises et les monastères des grandes centres byzantins*, Paris, 1975, esp. 311–13 for documentation on Daphni, which he assumed was dedicated to the Theotokos. Also E.R. Brown, 'The Cistercians in the Latin Empire of Constantinople and Greece, 1204–1276', *Traditio* 14 (1956), 63–120. The monastery was known as the monastery of Laurus: see J. Richard, 'Laurum, une abbaye cistercienne fantôme', *Bibliothèque de l'Ecole des Chartes* 139 (1971), 409–10.

5 G.P. Kremos, *Phokika I-III*, Athens, 1874–80; R. Weir Schultz and S.H. Barnsley, *The Monastery of Saint Luke of Stiris in Phocis*, London, 1901; A.H.S. Megaw, 'The chronology of some Middle-Byzantine churches', *Papers of the British School at Athens* 32 (1931-2), 90–130; M. Chatzidakis, 'A propos de la date et du fondateur de Saint-Luc', *Cahiers Archéologiques* 19 (1969), 127–50; E.G. Stikas, *The Building History of the Monastery of Hosios Loukas of Phocis* (in Greek), Athens, 1970; M. Chatzidakis, 'Précisions sur le fondateur de Saint-Luc', *Cahiers Archéologiques* 22 (1972), 89–113; E.G. Stikas, *The Founder of the Katholicon of the Monastery of Hosios Lukas* (in Greek), Athens, 1974–5; L. Bouras, *The Sculptural Decoration of the Church of the Virgin in the Monastery of Saint Luke* (in Greek), Athens, 1980; D. Mouriki, 'Stylistic trends in monumental painting of Greece during the eleventh and twelfth centuries', *Dumbarton Oaks Papers* 34–5 (1980–1), 77–124; T. Chatzidakis-Bacharas, *Les peintures murales de Hosios Loukas. Les chapelles occidentals*, Athens, 1982; D.I. Pallas, 'Zur Topographie und Chronologie von Hosios Lukas: eine kritische übersicht', *Byzantinische Zeitschrift* 78 (1985), 94–107; D. Mouriki, *The Mosaics of Nea Moni on Chios*, Athens, 1985; C.L. Connor, *Art and Miracles in Medieval Byzantium. The Crypt at Hosios Loukas and its Frescoes*, Princeton, 1991; N. Oikonomides, 'The first century of the Monastery of Hosios Loukas', *Dumbarton Oaks Papers* 46 (1992), 245–55; D.Z. Sophianou, *Hosios Loukas. His Life* (in Greek), Athens, 1993 (2nd edn), is a critical edition of the text in Kremos (ibid.), I, 25–62; C.L. and W.R. Connor, *The Life and Miracles of St Luke of Steiris. Text, Translation and Commentary*, Brookline (Mass.), 1994; N. Chatzidakis, *Hosios Loukas. Byzantine Art in Greece*, Athens, 1996 (in Greek), 1997 (in English); P.M. Mylonas, *Monastery of Hosios Loukas the Stiriotis: Architectural Analysis of the Four Churches*, Athens, 2005.

6 Schultz and Barnsley (n. 5) were incorrect on the relative order in which the two churches were built, but their view of the priority of the katholikon over the Panagia church held sway until the work of Stikas in 1965 reversed this (Stikas held that the Panagia church was the church of St Barbara, started in AD 946 and completed in AD 955. Bouras (n. 5) dated the Panagia church on the basis of style after AD 960.

7 See n. 5: the 1969 article was reprinted in M. Chatzidakis, *Studies in Byzantine Art and Archaeology* (Variorum Reprints), London, 1972, XII.

8 On the route of Basil's journey through Greece see: A. Kaldellis, *The Christian Parthenon. Classicism and Pilgrimage in Byzantine Athens*, Cambridge, 2009, esp. 81–91.

9 Published by Kremos I (n. 5), 71–132.

10 Chatzidakis 1996–7 (n. 5), esp. 10–12.

11 N. Chatzidakis, *Hosios Loukas*, Athens, 1982, dated the paintings of the two side chapels of the katholikon between 1035 and 1055.

12 Connor (n. 5), 122–3.

13 Mouriki 1985 (n. 5), 255.

14 For Cyril Mango's scepticism on the interpretation of this text as a dating indicator, see H. Belting, 'Byzantine art in southern Italy', *Dumbarton Oaks Papers* 28 (1974), 1–29, esp. fn. 49 on 15; and C. Mango, 'Les monuments de l'architecture du XIe siècle et leur signification historique et sociale', *Travaux et Mémoires* 6 (1976), esp. 364 (noted by Pallas [n. 5], 98).

15 Oikonomides (n. 5), 245–55.

16 Illustrated in Chatzidakis 1996–7 (n. 5), pl. 91, 88.

17 J. Nesbitt and J. Wiita, 'A confraternity of the Comnenian Era', *Byzantinische Zeitschrift* 68 (1975), 360–84; the initial document was re-copied some 50 years later and it is this copy which is preserved in Palermo.

18 R. Cormack, 'The apse mosaics of S. Sophia at Thessaloniki', *Deltion tes Christianikes Archaiologikes Etaireias* 10 (1980–1), 111–35; reprinted in R. Cormack, *The Byzantine Eye: Studies in Art and Patronage* (Variorum), London, 1989, V with additional notes.

19 Stikas 1970 (n. 5), 131 and pls 2 and 3 for a documentation of the damage and remaking of the mosaic along the fissure that also cut into the face of Thomas.

20 The point about the *pentimento* which is used here was also noted by Chatzidakis 1996–7 (n. 5), 75, but not by Connor (n. 5) in her description (at 39).
21 Anatole Frolow apparently considered the mosaicists to be formed by local art, but his solution that they were late 10th century and influenced by the Parthenon sculptures has not been found acceptable: see, A. Frolow, 'La date des mosaiques de Daphni', *Corso di cultura sull' arte ravennate e bizantina* IX (1962), 295–9.
22 H. Buchthal, 'Die Mosaiken von Daphni', *Sitzungsberichte, Kunstgeschichtliche Gesellschaft zu Berlin* Heft 6, N.F. (1958), 17.
23 The *Photothèque Millet* in the École Pratique des Hautes Études, Section des Sciences Religieuses, Paris is currently curated by Catherine Jolivet-Lévy (the plan to copy the holdings at the Index of Christian Art at Princeton has recently lapsed and the archive is petitioning for international funding and support).
24 The subsequent neglect and fate of his materials is discussed by O. Etinhof, 'Pyotr Ivanovich Sevastianov and his activity in collecting Byzantine objects in Russia', in R. Cormack and E. Jeffreys (eds), *Through the Looking Glass. Byzantium through British Eyes*, Aldershot, 2000, 211–20.
25 See Chlepa (n. 3), 86, figs 77–8.
26 Ibid., 86 and fn. 152.
27 Difficulties were encountered in replacing the prophets in the dome in their original positions in the reconstructed drum.
28 The relevant photographs for Daphni are B318-43 and C1341–83 (1892–8). The Strzygowski archive is at the Institute of Art History of the University of Vienna, digitized by DiFaB@univie.ac.at.
29 J. Shearman, *Only Connect: Art and the Spectator in the Italian Renaissance*, Princeton, 1992, 161–5.
30 The vertical tear is in the print of the photograph in the Conway Library, Courtauld Institute of Art. Robert Weir Schultz and Sidney Howard Barnsley recorded Daphni in a series of photographs and drawings during their period in Greece; according to the notebook in the BSA Archive, they worked in the building in March 1888, and in April, May and November 1889, and January and April 1890. They returned to England in November 1890, and never went back to Greece.
31 M. Chatzidakis, *Das Byzantinisches Athen*, Athens, no date, pl. 84.
32 J.C. Anderson in H.C. Evans and W.D. Wixom (eds), *The Glory of Byzantium*, New York, 1997, cat. no. 62, 107–9.
33 Diez and Demus (n. 1), 92–4.
34 Mouriki 1985 (n. 5), vol. I, 262–5.
35 Diez and Demus (n. 1), 112.
36 O. Demus, *The Mosaics of San Marco in Venice*, Chicago, 1984; the publications of Demus and Irina Andreescu on Torcello are listed in the exhibition catalogue: G. Caputo and G. Gentili (eds), *Torcello alle origini di Venezia tra Occidente et Oriente,* Venice, 2009, 181ff.
37 Demus (n. 36), 280–1.
38 The Torcello connection was recognized by R. Cormack, *An Apostle Mosaic from Medieval Torcello*, Lot 64, *European Works of Art sale, Sotheby's London*, 9 July 1987. It was further discussed, with useful corrections, by Irina Andreescu-Treadgold, in Evans and Wixom (n. 32), cat. no. 293, 452–3. The head is now in a private collection in New York, and a replica of it was made for placement in the church.
39 Andreescu-Treadgold (n. 38) argues for this time and not in the 1850s through the activities of the notoriously corrupt restorer Giovanni Moro.
40 Further investigation of the national archive at Aberystwyth might uncover the precise moment of purchase in 1885 (if that was the year), but my own search mediated through the help of the archivist Mr P.W. Davies in 1987 was inconclusive.
41 See cat. nos 15–18 of the exhibition catalogue by Caputo and Gentili (n. 36).
42 Diez and Demus (n. 1) published (pl. 98) Millet's record before restoration of the Betrayal of Judas panel (west wall, north arm of the narthex).
43 O. Demus, 'Zu den Mosaiken der Hauptapsis von Torcello', *Starinar* 20 (1969), 53–7 dates the lower section of the apse to the 1050s.

Chapter 24
The Abbot Philotheos, Founder of the Katholikon of Hosios Loukas
Old and New Observations*

Nano Chatzidakis

Introduction

Hosios Loukas is one of the most prominent monuments of medieval Byzantium and one of the most important monastic foundations in Greece. The grandeur of its construction and the splendour of its interior with marble revetment and mosaic decoration (**Pl. 1**) attracted scholarly interest[1] and restoration[2] at an early stage. Nothing is left of the monastery's archives and there is no direct information about either the founder of the monastery or the date of its foundation. A reference by Cyriacus of Ancona naming the Byzantine Emperor Constantine Monomachos (r. 1042–55) as the founder has never been supported by any reliable document. The iconographic programme (in mosaic) comprises only ten scenes and more than 170 individual saints. A saint's portrait in the nave and an impressive group of 26 monks are placed in the northwest and southwest bays. Among them is Nikon Metanoite, a local saint who died in AD 997, thus providing a secure *terminus post quem* for the mosaic decoration of the katholikon.[3]

The publication by Manolis Chatzidakis of a fresco representing an anonymous abbot who turns to offer the model of a wide-domed church to St Loukas standing frontally in prayer (**Pls 2–3**), provided new evidence for the identity of the founder of the katholikon.[4] The fresco was found in a special place of honour under an arch in the northeast compartment, flanking the sanctuary on its north and the saint's larnax on its west.[5] The abbot, who is depicted as an old man with a long white beard (**Pl. 3**), was identified on the basis of his facial features as Philotheos, the abbot of the monastery, who appears twice in the frescoes of the crypt:[6] first on a medallion on a groin vault along with three other abbots of the monastery, Theodosios, Loukas and Athanasios (**Pls 4, 6**), accompanied on the flanking

Plate 1 Interior of the katholikon at Hosios Loukas, general view towards the east

Plate 2 Drawing of the wall paintings of the northeast compartment with the abbot Philotheos donating the katholikon to Hosios Loukas

Plate 3 The abbot Philotheos offering the model of the katholikon. Wall painting, northeast compartment

groin vault by St Philotheos (**Pl. 6**) and the homonymous saints' patrons of the other three abbots (**Pls 5, 7**). The abbot Philotheos was distinguished a second time, with the same facial features, among a group of monks who pray to St Loukas in the entrance of the crypt.[7] The pious act of the katholikon's foundation by Philotheos was also mentioned in four canticles from the vespers of the *Akolouthia* of the Anakomidi (Service of the Translation of the Relic) of St Loukas,[8] explicitly praising his initiative in the translation of the saint's relics to the new church, the katholikon. According to this text, the translation took place on the day of the celebration of the Ascension on 3 May; according to the Grumel tables, this coincides only in the years 1011 or 1022.[9] It is notable that 3 May is still the most important feast day of the monastery – even more important than the name day of the saint (7 February).

Different opinions concerning both the founder of the monastery and its date have been expressed by Eustathios Stikas[10] and Paul Mylonas,[11] who disregarding the representation of Philotheos as a donor of the katholikon, insisted on the attribution of its foundation to the Emperor Constantine Monomachos; a different date, before the end of the 10th century, has been proposed by Carolyn Connor,[12] but this has been criticized by Christopher Walter[13] and myself,[14] who both point out that the depiction of Nikon Metanoite as a saint with a nimbus cannot have occurred before his death in AD 997. The above-mentioned opinions have also been criticized by Dimitrios Sophianos[15] who provided further arguments regarding the authentication and dating of the texts of the *Akolouthia* (the Service), which are proved to be contemporary with the translation of the relics of the saint into the new church, thus confirming Chatzidakis' theory. Charalampos Bouras considers the katholikon to be an accomplished creation, implying a genuine architectural project designed by a great architect, and founded by the abbot Philotheos;[16] he has also provided new arguments for dating its construction to 1011 after a marble inscription which refers to the marble decoration of a dependency of Hosios Loukas at Aliveri, Euboea, in the year 1014.[17]

Nicolas Oikonomides, in his study of the early years of the katholikon,[18] confirmed the crucial role played by Philotheos in the building of the katholikon in 1011 and adduced new evidence for the activity of the first abbots, also establishing identifications for two other abbots represented on the same groin vault as Philotheos in the crypt (**Pl. 4**):[19] Theodosios was identified with the famous abbot Theodoros Leovachos who, as is known from the *typikon* of the Virgin Naupaktiotissa,[20] ruled the monastery around 1048, and the abbot Loukas, depicted with a long white beard, was

Plate 4 The abbots Athanasios, Philotheos, Luke and Theodosios on a groin vault in the crypt

Plate 5 Patron saints of the homonymous abbots (see Plate 4) on a groin vault in the crypt

Plate 6 The abbot Philotheos, detail of the groin vault (Plate 4)

Plate 7 St Philotheos, the priest, patron saint of the homonymous abbot (detail of the groin vault, Plate 5)

Plate 8 St Philotheos, the priest, detail of the mosaic in the entrance to the diakonikon

identified with the eponymous abbot ruling the dependency of Hosios Loukas at Aliveri at the beginning of the 11th century as indicated by an inscription of 1014 which mentions his death in 1005.[21]

Following this short introduction I will focus on the unnoticed, until now, presence of the abbot Philotheos in the mosaic decoration of the katholikon and on some already known written material. I will comment first on the figure of St Philotheos in the diakonikon and then revisit the canticles of the *Akolouthia* of the translation of the relics of St Loukas and the dedicatory inscription of Gregorios on a marble slab inserted in the marble decoration of the narthex.

St Philotheos in the mosaic decoration of the diakonikon

In the mosaic decoration of the entrance to the diakonikon is the figure of a saint accompanied by the inscription 'ΑΓΙΟΣ ΦΙΛΟΘΕΟΣ' (St Philotheos) (**Pl. 8**). He has a round face with large eyes, short brown hair and a neat beard. He is represented full length as a simple priest wearing a purple tunic and *encheirion* and holding a book and a small cross. His facial features and costume are exactly the same as on the portrait of St Philotheos represented as the patron saint of the abbot Philotheos on the groin vault of the crypt (**Pl. 6**).

But who was St Philotheos? His known representations are extremely rare; he appears in the *Menologion* of Basil II (Vat. Gr. 1613, fol. 38)[22] with the same facial features and priest's costume (including the *epitracheilion*).The only source of his life is the *Synaxarium Ecclesiae Constantinopolitanae*, where he is celebrated on 15 September.[23] According to this short text, Philotheos was a priest from the town of Myrmikos in the theme of Opsikion in Asia Minor; he was married to a good woman and was the father of children; he died in peace. Only one event is explicitly described in this short text: he resisted the translation of his relics to another place by appearing miraculously in front of those who wanted to enact this translation and by insisting that his relics should remain where they were originally buried. It is notable that Hippolyte Delehaye, the editor of the *Synaxarium*, suggests that St Philotheos was a 10th-century saint probably contemporary with St Loukas.[24] One could also remark on the coincidence of events regarding the translation of the relics of the two saints as we know that the relics of St Loukas were translated to the new katholikon in a larnax and put exactly above the place where he was first buried.[25]

A parallel examination of the display of the saints in the mosaic decoration of the entrance to the prothesis and to the diakonikon (**Pl. 1**) provides us with some useful information about the prevailing criteria for their choice and placement:

Prothesis (**Pl. 9**)	Diakonikon (**Pl. 10**)
1. Gregory the Great of Armenia	1. Gregory of Nyssa
2. Ignatios Theophoros (of Antioch)	2. Philotheos, priest
3. Clement (of Rome)	3. Hierotheos (of Athens)
4. Cyril of Alexandria	4. Dionysios Areopagites (Athens)

One may remark that in the prothesis there are represented four hierarchs and in the diakonikon three hierarchs and a simple priest named Philotheos. Furthermore, a symmetrical arrangement of the two homonymous Great Fathers of the church, Gregory of Armenia and Gregory of Nyssa,[26] is noteworthy. In this context, St Philotheos as a simple priest appears as an intrusive figure. This is clearer if we consider the whole decoration of the diakonikon which exclusively comprises the figures of bishops: on the groin vault, Antipas, Anthimos, Eleutherios and Polykarpos, and on the inner arch, Spyridon, Achilleios, Silvester and Kyprianos.[27] One can also assume that the destroyed original mosaic decoration of the prothesis (groin vault and inner arch), also comprised a similar programme with hierarchs.

St Philotheos the priest is placed among two illustrious hierarchs of the city of Athens – St Hierotheos and St Dionysios (**Pl. 10**): the former was the first bishop of Athens who was appointed to this post by St Paul.[28] His cult in the region of Attica is known from the 12th-century church

Pl. 9 Gregory of Armenia, Ignatios, Clement and Cyril of Alexandria, detail of the mosaic in the entrance to the prothesis

Plate 10 Gregory of Nyssa, St Philotheos the priest, Hierotheos and Dionysios Areopagites, detail of the mosaic in the entrance to the diakonikon

dedicated to his name, Hagios Hierotheos near Megara.[29] St Dionysios Areopagites, a noble Athenian and a member of the *Areios Pagos* (Supreme Tribunal), was a disciple of Hierotheos who converted to Christianity after St Paul's sermon on the rock of Areios Pagos adjacent to the Acropolis; he was thus considered as the protector of the city of Athens.[30] During the 10th century he was a well-known saint included in the text of Elpius,[31] where the description of his facial features corresponds to those in the mosaic of Hosios Loukas; he appears also in the 10th-century mosaic decoration of Hagia Sophia in Constantinople, but without the epithet Areopagites.[32] Thus, the added epithet Areopagites in Hosios Loukas could indicate a special emphasis on his place of origin. In this context the placing of the priest Philotheos among the two founders of Athens' first church could be considered as a telling allusion to a related and crucial visit by St Loukas to Athens *c.* AD 910–11, where, according to his *Vita*, he prayed in a church of the Virgin (probably the church on the Parthenon) and was converted to the monastic life in a monastery which remains as yet unidentified.[33]

In conclusion, the presence of Philotheos the priest in the mosaic decoration of the diakonikon suggests that there was a special purpose in honouring the prodigious activity of the homonymous holy abbot for the foundation of the katholikon and for the translation of the miraculous relics of St Loukas.

The written sources

The canticle of the Akolouthia

I shall now proceed with a re-examination of four of the canticles written for the *Akolouthia* of the translation of the relics of St Loukas and on the occasion of the inauguration of the new church, the katholikon, already known from the studies of Manolis Chatzidakis[34] and Demetrios Sophianos.[35] They were composed during a period when the abbot Philotheos was still alive and most probably before the end of the incursions of the Bulgars in the region in 1018 when Basil II visited Athens on pilgrimage.[36] Three canticles of the first canon (two of the fifth ode and one of the sixth ode) and one canticle of the ninth ode of another independent canon, related to the translation, contain the name of the abbot Philotheos (Φιλόθεος, underlined) three times as the founder of the katholikon and responsible for the translation of the relics of St Loukas to the new church (katholikon). On those verses we can add some more observations:

Ἀπὸ ψυχῆς
φιλοθέου, παμμάκαρ,
κεκινημένος,
ἔσπευσεν ὁ Φιλόθεος *φιλοθέως*
σὲ καταθεῖναι
ὡς ἀπόθετον χρῆμα
ἐν τῇ θήκῃ, ἣ νῦν κατάκεισαι,
πρότερον ἐν γῇ
τεθαμμένον καὶ μύρον βλύζοντα.
(...)
Ναόν σε γεγονότα
Τριάδος ἱερόν
τῆς παναγίας, Λουκά παμμακάριστε,
μετέθετο ὁ Φιλόθεος ναῷ
ἐν καινῷ, ὃν ἤγειρεν
εἰς σὸν ὄνομα πιστῶς.
****

Ὁ ποίμνην σου ποιμαίνων τὴν λογικήν
φιλοθέως, Λουκᾶ παμμακάριστε,
πόθῳ θερμῷ
πίστει τε κινούμενος τῇ πρὸς σέ,
ὡς ἀληθῶς *φιλόθεον*
ἔργον, τὴν σεπτὴν ἀνακομιδὴν
τοῦ θείου σου λειψάνου
εἰργάσατο ἐμφρόνως,
ὢν καὶ καλούμενος Φιλόθεος.[37]

The word 'philotheos' occurs four more times (underlined and italicized): first as an epithet, φιλόθεος, meaning 'the one who loves God', and second as an adverb, φιλοθέως, meaning 'with the love for God', in a poetical play (alliteration) on the proper name of the abbot Φιλόθεος. With the special emphasis given to this term, which appears in total four times in the same canticles and in close relation to the name of Philotheos mentioned in the same verses three times, the author of these canticles intended to emphasize not only the name but also the venerable act of the abbot who was responsible for the translation of the relics and the building of the new church, the katholikon of Hosios Loukas.

The marble inscription

This interpretation can be confirmed if we revisit the first of the already known dedicatory inscriptions on two small white marble slabs inserted in the marble revetment and flanking the upper part of the central entrance from the narthex to the nave of the katholikon.[38] The first (l. 0.24m; h. 0.19m), is placed to the left of the entrance (**Pls 11**–**12**).

ΛΟΥΚΑ ΤΡΙΣΜΑΚΑΡ ΤΟ
ΦΙΛΟΘΕΟΝ ΕΡΓΟΝ
ΓΛΥΦΕΝ ΔΕΧΟΙ
Ο ΕΚ ΧΕΙΡΩΝ ΓΡΗΓΟ
(Λουκᾶ τρισμάκαρ τὸ / φιλόθεον ἔργον / γλυφὲν δέχοι / ὁ ἐκ χειρῶν Γρηγο//).

The inscription continues on the second slab:

ΡΙΟΥ ΟΠΕΡ ΤΕΤΕΥΧΕ
ΠΡΕΣΒΕΙΑΙΣ ΣΟΥ ΘΑΡ

Plate 11 Dedicatory marble inscription in the narthex

ΡΗΣΑΣ ΔΙΔΟΥϹ ΕΙϹ ΠΕ
ΡΑϹ ΚΑΙ ΝϹΝ ΟΦΛΗΜΑ
ΤΩΝ+

(-ρίου ὅπερ τέτευχε / πρεσβείαις σου θαρ/ρήσας δίδου εἰς πέ/ρας καὶ λύσιν ὀφλημά/των +. 'Thrice blessed Luke receive at the hands of Gregory, this pious work of sculpture which he has wrought by thy intercessions, giving it for the ending and remission of sins').[39]

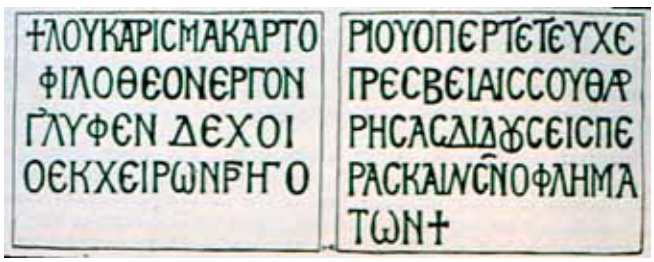
This inscription, which refers to the offering of the pious work of supervising (or commissioning) the marble revetment of the church by Gregorios,[40] comprises the epithet φιλόθεον once more, in order to characterize the ἔργον (underlined), meaning here the pious act of the building of the katholikon, in a poetical allusion to the name of the abbot Philotheos. Furthermore, we can observe that in the above-mentioned canticle for the translation of St Loukas' relics, this same expression, 'φιλόθεον ἔργον', recurs one more time (in italics):

'Ο ποίμνην σου ποιμαίνων τὴν λογικήν
φιλοθέως, Λουκᾶ παμμακάριστε,
πόθῳ θερμῷ
πίστει τε κινούμενος τῇ πρὸς σέ,
ὡς ἀληθῶς *φιλόθεον*
ἔργον, τὴν σεπτὴν ἀνακομιδὴν
τοῦ θείου σου λειψάνου
εἰργάσατο ἐμφρόνως,
ὢν καὶ καλούμενος Φιλόθεος

The word ἔργον meaning here, the act of the translation of the relics of St Loukas.

The previous remarks offer an interesting echo of the prevailing intellectual climate at that time in the monastic milieu of Hosios Loukas. We cannot know if the author of the text of the marble inscription was the donor of the marble revetment of the katholikon, Gregorios. On the other hand, the use of similar expressions in both cases does not allow us to assume that the author of both texts was one and the same; however, we can suggest that the author of the text of the inscription was aware of those canticles and most probably contemporary with their author. Seen in this context the presence of the abbot Philotheos, either explicit or concealed, in the mosaic or fresco decoration as well as in the dedicatory inscriptions and the texts of the *Akolouthia* of 3 May, reveals once more the erudite as well as the intricate thought processes that shaped the iconography of the katholikon. The evident honour given discretely to the person responsible for the translation of the relics of St Loukas to a new and larger church, appropriate for the needs of a growing pilgrimage centre, should be obviously discernible not only to the learned monks of this monastic foundation, but also to the high-ranking visitors from the neighbouring city of Thebes.[41]

Plate 12 Drawing of the dedicatory marble inscription (see Plate 11)



Notes

* A longer version of this paper has been published in *Cahiers Archeologiques* 54 (2011–2012), 17–32: N. Chatzidakis, 'La présence de l'higoumène Philothéos dans le catholicon de Saint-Luc en Phocide (Hosios Loukas). Nouvelles remarques'.

1 G. Kremos, *Φωκικά, Προσκυνητάριον της εν Φωκίδι Μονής του Οσίου Λουκά*, 3 vols, Athens, 1874–80; R.W. Schultz and S.H. Barnsley, *The Monastery of Saint Luke of Stiris in Phokis and the Dependent Monastery of Saint Nicolas in the Fields near Skripou in Boeotia*, London and New York, 1901; E. Dietz and O. Demus, *Byzantine Mosaics in Greece, Hosios Lucas and Daphni*, Cambridge (Mass.), 1931.

2 E. Stikas, *Το οικοδομικόν χρονικόν της μονής του Οσίου Λουκά*, Athens, 1970.

3 N. Chatzidakis, *Hosios Loukas* (Byzantine Art in Greece), Athens, 1997, 22–3, fig. 9, nos 126–51, figs 36–42; N. Oikonomides, 'How to become a saint in eleventh century Byzantium', in E. Kountoura-Galake (ed.), *The Heroes of the Orthodox Church, The New Saints, 8th–16th centuries* (National Hellenic Research Foundation, Institute for Byzantine Research, International Symposium 15), Athens, 2004, 473–91, esp. 484–9; N. Patterson-Sevcenko, 'Three saints at Hosios Loukas', in Kountoura-Galake ibid., 459–72.

4 M. Chatzidakis, 'À propos de la date et du fondateur de Saint-Luc', *Cahiers Archéologiques* 19 (1969), 127–50, reprinted in M. Chatzidakis, *Studies in Byzantine Art and Archaeology* (Variorum Reprints), London, 1972a, no. XII; M. Chatzidakis, 'Περί μονής Οσίου Λουκά νεώτερα', *Ελληνικά* 25 (1972b), 298–313; M. Chatzidakis, 'Précisions sur le fondateur de Saint-Luc', *Cahiers Archéologiques* 22 (1972c), 87–8.

5 Chatzidakis (n. 3), 54–5, figs 50–1.

6 Ibid., 84, 90–1, figs 84–5, 96–7.

7 Ibid., figs 96–7.

8 Chatzidakis 1969 (n. 4); D. Sophianos, 'Η Μονή του Οσίου Λουκά. Έλεγχος και κριτική της αξιοπιστίας και ερμηνείας των πηγών', *Μεσαιωνικά και Νέα Ελληνικά* 4 (1992), 23–80.

9 Chatzidakis 1969 (n. 4).

10 Stikas (n. 2).

11 P. Mylonas, 'Nouvelles remarques sur le complexe de Saint-Luc en Phocide', *Cahiers Archéologiques* 40 (1992), 115–22 (with previous bibliography).

12 C. Connor, *Art and Miracles in Medieval Byzantium: The Crypt at Hosios Loukas and its Frescoes*, Princeton, 1991.

13 C. Walter in: *Revue des Études Byzantines* (1992), 334–5 (Book review).

14 N. Chatzidakis in: *Burlington Magazine* 136, no. 1090/1 (1994), 30–1 (Book review).

15 D. Sophianos, *Όσιος Λουκάς, Ο βίος του οσίου Λουκά του Στειριώτη: Προλεγόμενα, μετάφραση, κριτική έκδοση του κειμένου*, Athens, 1989; Sophianos (n. 8).

16 C. Bouras, *Byzantine and post-Byzantine Architecture in Greece*, Athens, 2006, 92, 103, 106; C. Bouras, *Τρόποι εργασίας των βυζαντινών αρχιτεκτόνων και αρχιμαστόρων* (English summary: Working methods of the Byzantine architects and master builders),

Ακαδημία Αθηνών (Μνήμη Μανόλη Χατζηδάκη, 4 March 2008), Athens, 2010, 23–4, 41.

17 C. Bouras, 'Παρατηρήσεις στο καθολικό της μονής της Θεοτόκου Περιβλέπτου στα Πολιτικά της Εύβοιας', *Αρχείο Ευβοϊκών Μελετών* 28 (1988–9), 53–62.

18 N. Oikonomides, 'The first century of the monastery of Hosios Loukas', *Dumbarton Oaks Papers* 46 (1992), 245–55.

19 Chatzidakis (n. 3), figs 85, 91–5.

20 J. Nesbitt and J. Witta, 'A confraternity of the Comnenian era', *Byzantinische Zeitschrift* 68 (1975), 360–84; T. Chatzidakis-Bacharas, *Les peintures murales de Hosios Loukas: les chapelles occidentales* (Tetradia Christianikis Archeologikis Etaireias No 2), Athens, 1982, 105–6, 183–8.

21 Bouras (n. 17); G. Velenis, 'Επιλεγόμενα σε επιγραφές του μετοχίου του Οσίου Λουκά Εύβοιας', in *Αρμός, τιμητικός τόμος Ν. Μουτσόπουλου*, Thessaloniki, 1991, 351–61.

22 *Lexikon der christlichen Ikonographie*, 8 vols, J. Kirschbaum and W. Braunfels (eds), Rome-Fribourg-Bale/Vienna, 1976, 8, 208.

23 *Synaxarium Ecclesiae Constantinopolitanae*, *Propylaeum ad Acta SS Novembris* (ed. H. Delehaye), Brussels, 1902, col. 47; A.P. Kazhdan (ed.), *The Oxford Dictionary of Byzantium* (hereafter *ODB*), 3 vols, New York/Oxford, 1991, vol. 3, 1663.

24 *Synaxarium* (n. 23), col. 47.

25 Chatzidakis 1969 (n. 4), 128; see also, Schultz and Barnsley (n. 1), 34.

26 *ODB* 2, 882–4.

27 Chatzidakis (n. 3), 22–3, fig. 9, nos 20–7.

28 *Synaxarium* (n. 23), col. 103.

29 D. Mouriki, 'Stylistic trends in monumental painting of Greece during the eleventh and twelfth centuries', *Dumbarton Oaks Papers* 34–5 (1980–1), 77–123, esp. 111, pls 63–7.

30 *Synaxarium* (n. 23), cols 101–2; *ODB* 1, 629.

31 M. Chatzidakis, 'Εκ των Ελπίου του Ρωμαίου', *Επετηρίς της Εταιρείας Βυζαντινών Σπουδών* 14 (1938), 393–414, esp. 412 (reprinted in Chatzidakis 1972a (n. 4), no III).

32 C. Mango and E.W.J. Hawkins, 'The mosaics of Hagia Sophia at Istanbul, the Church Fathers in the north tympanon', *Dumbarton Oaks Papers* 26 (1972), 3–41, figs 57, 59.

33 Sophianos (n. 8), 132 and 16–17; Bouras 2010 (n. 16), 134–40, 266–7.

34 Chatzidakis 1969 (n. 4), 130.

35 Sophianos (n. 8), 24–37, 70–9.

36 Sophianos (n. 8), 26–37; Oikonomides (n. 18), 253–4.

37 Sophianos (n. 8), 70–1.

38 Schultz and Barnsley (n. 1), 28.

39 Translation by: Schultz and Barnsley (n. 1), 28.

40 Chatzidakis 1969 (n. 4), 141, n. 36.

41 Oikonomides (n. 18).

Chapter 25
Recording Byzantine Mosaics in 19th-century Greece
The Case of the Byzantine Research Fund (BRF) Archive

Dimitra Kotoula (with a contribution from Amalia G. Kakissis)

'The present situation in Greece does not allow the immediate planning of excavations…the monuments, however, should be revealed at least up to the level of the ancient city. The little picturesque church remains of the Byzantine Middle-Ages could be preserved where these create a lovely contrast with the works of art of Antiquity.' (Eduard Schauber – Stamatis Kleanthis, *Memorandum*, 1833)[1]

By the time Robert Weir Schultz and Sidney Howard Barnsley, young architects of the London Royal Academy of Arts visited Greece for the first time in early 1888, the attitude towards surviving Byzantine monuments reflected in the Bavarian *Memorandum* for the planning of Athens as the capital of the newly formed Greek state had already started to change.[2] The foundation of the British Society of Dilettanti (1732) formalized the study of classical art and architecture establishing the canonical modes of rational documentation for the ever-growing number of amateur travellers, antiquarians and Grand Tourists.[3]

Philhellenism, which, in its early form grew out of the context of Romanticism during the late 18th century, gradually shifted interest to Greece.[4] Mass travel began, producing a versatile corpus of narratives, poetry, graphic works and, to a lesser degree, scientific descriptions and illustrations, with particular reference to the reality of modern Greece and its people.[5] However, despite the formalization of the academic study of antiquity, a looser psychological approach was still largely in practice as far as the post-antique monuments and remains were concerned at least up until the beginning of the 19th century: Byzantine, Venetian/Frankish or even Ottoman architecture and art was still seen in constant dialogue with the more familiar classical past, through the lens of a subjective and somewhat exotic approach.[6] In fact, the true interest in and reappraisal of the Byzantine art and architecture of the Greek mainland and the islands coincided with the expansion and development of historical studies.[7] The subsequent emergence of Byzantine art history as an academic discipline among French, German and later Russian scholars fuelled further interest in the field.[8] Finally, the 'neo-Gothic' or the 'neo-Greek' revival in the arts as a first response to the influx of the early documentation of Byzantine monuments contributed even further to their re-evaluation in mid-19th-century Europe.[9]

Energetic teams combining scholarly skills and artistic draughtsmanship from Germany, Russia, France and later Britain, hosted by the newly founded foreign archaeological schools in Athens, played a key role in the appropriation of post-classical Greek culture.[10] The group of British architects who undertook between 1888 and 1949 the systematic investigation, recording and publication of Byzantine art and architecture under the auspices of the British School at Athens was to form in 1908 the so-called Byzantine Research and Publication Fund.[11] How far did Byzantine mosaic cycles interest these proto-scholars? What new information did these architects and first members of the British School contribute to the study of the relevant cycles? Based on archival resources, to what extent can their working methods be reconstructed as far as this medium is concerned, and did it actually differ from that of other contemporary scholar-architects in the field?

Mosaic cycles, mainly those of Ravenna, Rome and, later, Constantinople, attracted scholarly interest as soon as Byzantine art history started to develop as a professional discipline.[12] The mosaic panels in the church of Hagia Sophia, Constantinople, reproduced by the architects Giuseppe and Gaspare Fossati between 1847 and 1849, were in fact among the very first Byzantine works of art to be welcomed with keen enthusiasm in Europe.[13] However, as far as Greece is concerned, the study of mosaics does not seem to have been much of a priority. Apart from sporadic reproductions of figures and scenes or rough sketches showing their position inside the church interior we lack a coherent documentation of Byzantine mosaic cycles at least until up to the end of the 19th century.

André Couchaud was one of the first scholars to study closely the major Byzantine monuments of the Greek mainland with mosaic decoration during his research trips between 1842 and 1847. Although he offers in his valuable publication an array of accurate architectural drawings, he seems not to have been interested in the decoration.[14] Detailed reproductions of mosaic pavements and ornamental motifs only sporadically enliven the text of the consistently influential *Byzantine Architecture* by Charles Texier, who worked with the assistance of Richard Popplewell-Pullan on the monuments of Greece and Asia Minor as early as 1834.[15] As far as more general 19th-century Byzantine art histories are concerned, these either include no illustrations at all, such as Albert Lenoir's study on selective monuments of the Christian world, or reproduce rather crude engravings and sketches of little interest.[16] Adolphe Napoléon Didron's *Christian Iconography* includes a few rough sketches mainly of church exteriors and sculpture by Paul Durand, the artist who accompanied him on his travels to Greece and Turkey (1834–40).[17] Charles Bayet's influential and pioneering *Byzantine Art* seems to ignore Greece and, although it was published as part of a teaching series, copies crude reproductions from previous editions (mainly those by Labarte, Didron, M. de Vogüé, Unger and Salzenberg).[18] The same author, in his earlier *Recherches*, where he devotes a whole chapter (Chapter 3) to the history of the Byzantine mosaic, refers to Texier and Pullan's documentation of selective monuments of Thessaloniki without, however, reproducing any of them.[19]

It was during their short initial visit to Greece that Robert Weir Schultz and Sidney Howard Barnsley had realized the great lack of detailed information on the Byzantine monuments there. Their particular interest in mosaic cycles was already apparent well before their arrival. On their way to Athens early in 1888, and probably on their return in July of the same year, they visited Italy. During their short stay there they produced *inter alia* preliminary pencil and ink drawings of the marble revetments in the church of San Vitale, Ravenna, the *opus sectile* floor in the Baptistery of San Giovanni in Florence and the marble revetment and dome mosaics in the church and Baptistery of San Marco in Venice. Both would return to San Marco in the autumn of the following year to reproduce the *opus sectile* floor in the nave as well as further details of the decoration.[20]

Equally important to them before they set off, as well as in the later intervals between fieldwork, were publications of the period focusing on Byzantine mosaic cycles in Italy and Constantinople. They were familiar with Emile Caron's study, André Leval's detailed documentation of the decoration in the Chora monastery (Kariye Camii), Demetrio Salazaro's general study of medieval Italian monuments as well as of the more specific works by Henry Barbet de Jouy and Giovanni Battista de Rossi on the wall revetments and pavements in the Christian churches of Rome, and finally, Charles Diehl's and Jean Paul Richter's early publications on the mosaic cycles of Ravenna.[21] Finally, copied in the notebooks they consistently kept throughout their research are large extracts on the art of the mosaic from general Byzantine art histories such as those by Bayet and Lenoir.[22]

Schulz and Barnsley set clear goals for their research: both the architecture and the decoration of the major Byzantine churches of the Greek mainland were to be fully documented, studied and, if possible, published. In the preface to their 1901 publication on the art and architecture of the monastic complex of Hosios Loukas in Phocis – the only monograph to appear by Weir Schultz and Barnsley – they stress the importance of architectural archaeology and alert the readers to the danger that the results of similar research might remain unpublished due to the lack of available funds.[23]

Strongly dissatisfied with the work of their predecessors in the field, they were particularly critical of Texier and Pullan's edition as being full of inconsistencies, while reproduced in their sketch folders are drawings from Couchaud's *Choix d' églises Byzantines*, a publication which they found surprisingly poor on iconography.[24] Monographs on the monuments they were planning to document fully were meticulously studied and, at a later stage, revised.[25] From November 1889, when they returned to Greece through a special appeal, and for 12 months solid they managed to visit and record approximately 50 Byzantine churches producing hundreds of drawings and photographs. The two monuments that attracted their main interest and became the focus of their research were those with partly or fully surviving mosaic decoration: the monastic complexes of Daphni, northwest of Athens, and Hosios Loukas in Phocis, central Greece. A major part (more than a third) of the material that Weir Schultz and Barnsley produced was devoted to the study of these two monuments. This material along with all the other items that Weir Schultz and Barnsley created became the core material of the Byzantine Research Fund Archive.

When Weir Schultz and Barnsley first arrived at Daphni restoration work on the mosaic cycle that had suffered severely from earthquakes in the late 1880s (in 1886 and again in 1889) had just begun under the supervision of the German-educated theologian and archaeologist Georgios Lambakes, then General Secretary and one of the founding members of the newly established Christian Archeological Society (December 1884).[26] During their two visits to the monument (in early 1888 and at sometime between November 1889 and November 1890), they recorded almost all the surviving decoration producing preliminary or final inked drawings as well as a series of photographic plates.[27] On their second visit they had the chance to observe and

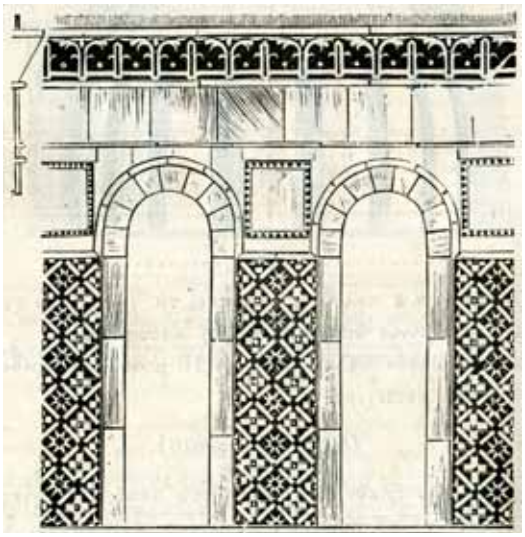


Plate 1 Marble wall revetment, bema (east apse), katholikon of the Daphni monastery, Attica. Partly revised annotated coloured drawing by Robert Weir Schultz and Sidney Howard Barnsley, pencil and watercolour, 34 x 25cm, 28 April 1888 (*BSA, BRF Archive*: Drawings: BRF 01.01.01.196)

Plate 2 Marble wall revetment, bema (east apse), katholikon of the Daphni monastery, Attica. Revised black and white reproduction by Emmanouel Lambakes (after G. Lambakes, *Christian Archaeology of the Daphni Monastery*, Athens, 1889, 106)

document fully (from the scaffolding constructed after the severe earthquake of January 1889) the figures and scenes that initially they did not have the chance to record. The Pantocrator of the central dome is one of the most representative examples: they produced, most likely during their first visit, a preliminary pencil drawing of it from ground level and later, during their second visit (probably in 1890), they took a photograph of it from atop the scaffolding.[28]

Weir Schultz and Barnsley actively followed the progress of restoration work at Daphni. In his revised publication which appeared in 1899, a decade after his initial study of the monument, Lambakes describes how in 1890 they themselves constructed scaffolding in front of a severely damaged scene and cleaned it demonstrating unique conservation skills.[29] In notebook entries dated to January and April of the same year, a series of valuable corrections and proposals have been recorded that illuminate further obscure or uncertain points raised by Lambakes in his initial 1889 monograph.[30] It is in this study that the author expresses his gratitude towards the 'two young English architects', praises the accuracy of their plans and reproduces a revised version – in black and white – of their documentation of the partly damaged marble revetment on the wall of the east apse which did not survive (**Pls 1, 2**).[31]

Plate 3 Marble wall revetment, bema (east apse), katholikon of the Daphni monastery, Attica. Black and white photographic plate by Robert Weir Schultz and Sidney Howard Barnsley, reproduced by G. Millet (after G. Millet, *Le monastère de Daphni: histoire, architecture, mosaïque*, Monuments de l' art byzantin, no. 1, Paris, 1899, fig. 39)

Although assisted in his research by his two brothers – Ioannis, a professional photographer and Emmanouel, a skilled painter and assistant to the German philhellene artist Ludwig Thiersch, who was particularly influential in the 19th-century Greek art scene – Lambakes merely includes scant visual material of rather bad quality in both his Daphni publications.

Weir Schultz and Barnsley had the opportunity to record not only surviving figures and scenes but also to produce accurate and detailed drawings of the monument's ornamental bands and friezes with distinctive geometric and floral motifs.[32] Their real interest in ornamental qualities, craftsmanship, the applied techniques and the materials used, which had already been apparent during their earlier Italian trip, is evident in the research they undertook later. Surviving notebook entries include, copied from Lambakes' first publication on the Daphni monastic complex, a detailed glossary of applied Byzantine mosaic techniques.[33] They tried to identify some of these techniques by collecting fallen tesserae in various colours, which they later labelled, attached to boards and stored, as well as pieces showing clearly the arrangement of the cubes on the alternate layers of the wall surface preparation.[34] Selective drawings of figures and scenes reflect the mosaicists' craft by trying to reproduce the actual appearance and texture of the mosaic surface, a technique that subsequent members of the Fund would later explore further.[35] For the final inked drawings the two architects would consult preliminary sketches recorded in their notebooks as well as black and white photographs in order to produce the most accurate result possible (**Pls 4–5**). However, despite these attempts at faithful reproduction rough outlines were still drawn to complete damaged or partly surviving figures and scenes, a corrective practice adhering to the traditional 19th-century principle: 'the viewer should be moved by the impact not of the relic but of the masterpiece' (**Pls 6–7**).[36]

Besides Weir Schultz and Barnsley, other Russian, German and French scholars were also actively documenting Daphni in the late 1890s. The French scholar Gabriele Millet, who was awarded in 1891 a residency by the French Archaeological School in Athens to record Byzantine monuments in Italy, Greece and the Balkans,

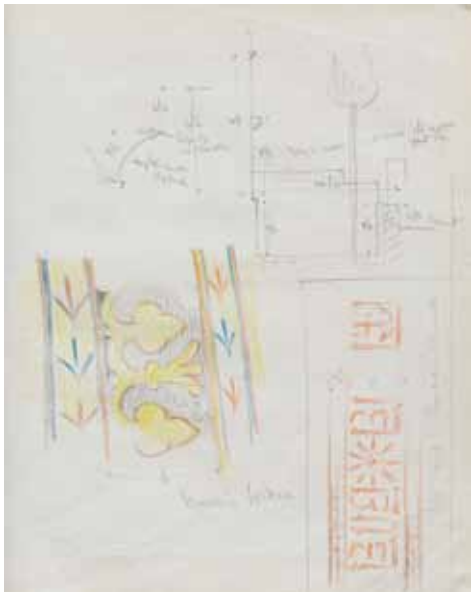


Plate 4 Annotated preliminary sketch of the part of mosaic frieze, narthex, katholikon of the Daphni monastery, Attica, by Robert Weir Schultz and Sidney Howard Barnsley, 25 April 1888 (*BSA BRF Archive*: Notebooks: SCH 5 ('Athens, Daphne, Mistra', March–April 1888)

Plate 5 Part of the mosaic frieze, narthex, katholikon of the Daphni monastery, Attica. Annotated coloured drawing by Robert Weir Schultz and Sidney Howard Barnsley, pencil and watercolour, 34.5 x 25cm, 1890 (*BSA, BRF Archive*: Drawings: BRF 01.01.01.166)

published in 1899 the results of his research in a monograph entitled *Le monastère de Daphni: histoire, architecture, mosaïque*.[37] For the documentation of the church and its decoration Millet primarily worked with artists, a typical trend in 19th-century scholarship.[38] His publication includes aquarelles by the artist Pierre Benouville executed in 1877 and some photographs and helio engravings – intaglio prints produced by gravure – of almost all the surviving figures and scenes.[39] Millet was familiar with Weir Schultz and Barnsley's working method and its results. In fact, Weir Schultz is thanked in the preface of the monograph for contributing a photograph showing the half-destroyed marble revetment in the monastery's east apse (**Pl. 3**).[40] For his reconstruction of the decoration in the same part of the church, Lambakes used Weir Schultz and Barnsley's drawings in his own 1889 publication. Although Millet's documentation appears to be more accurate than Lambakes' rather arbitrary reproduction, his overall analysis of the mosaic cycle owes little to archaeological observation concentrating instead on compositional and stylistic concerns while technique does not seem to interest him at all.

Similar principles appear to be predominant in the 19th-century study of another major Byzantine monument that Weir Schultz and Barnsley were also planning to document. Charles Diehl's monograph on the monastery of Hosios Loukas in Phocis appeared in 1889.[41] The publication was studied very carefully by Weir Schultz and Barnsley as is evident from the large extracts from the book which they included in their notebooks together with meticulous descriptions of the mosaic cycle.[42] Their 1901 publication of the monument and its decoration can in fact be studied as a reaction to Diehl's study. The emphasis on documentation, observation and technique – the principal characteristics of their working method – created a sharp contrast with Diehl's methodology which appeared heavily dependant on the literature and previous scholarship. The scant illustrations in Diehl's study – the book in fact contains only an attached plan, three inked black and white sketches of the monument's marble pavement with an indication of the colours, and some rough sketches of the windows – are replaced in Weir Schultz and Barnsley's publication by a series of detailed inked drawings, colour lithograph

Plate 6 The Prophet Ezekiel (actual size), dome mosaic, nave, katholikon of the Daphni monastery, Attica. Partly revised annotated coloured drawing by Robert Weir Schultz and Sidney Howard Barnsley, pencil and watercolour, 56 x 39.5cm (*BSA, BRF Archive*: Drawings: BRF 01.01.01.187)

Plate 7 The Prophet Ezekiel, dome mosaic, nave, katholikon of the Daphni monastery, Attica. Black and white photographic plate by Robert Weir Schultz and Sidney Howard Barnsley, 21.5 x 16.5cm (*BSA BRF Archive*: R.Weir-Schultz, S.H. Barnsley photographic collection: WI.G. 32)

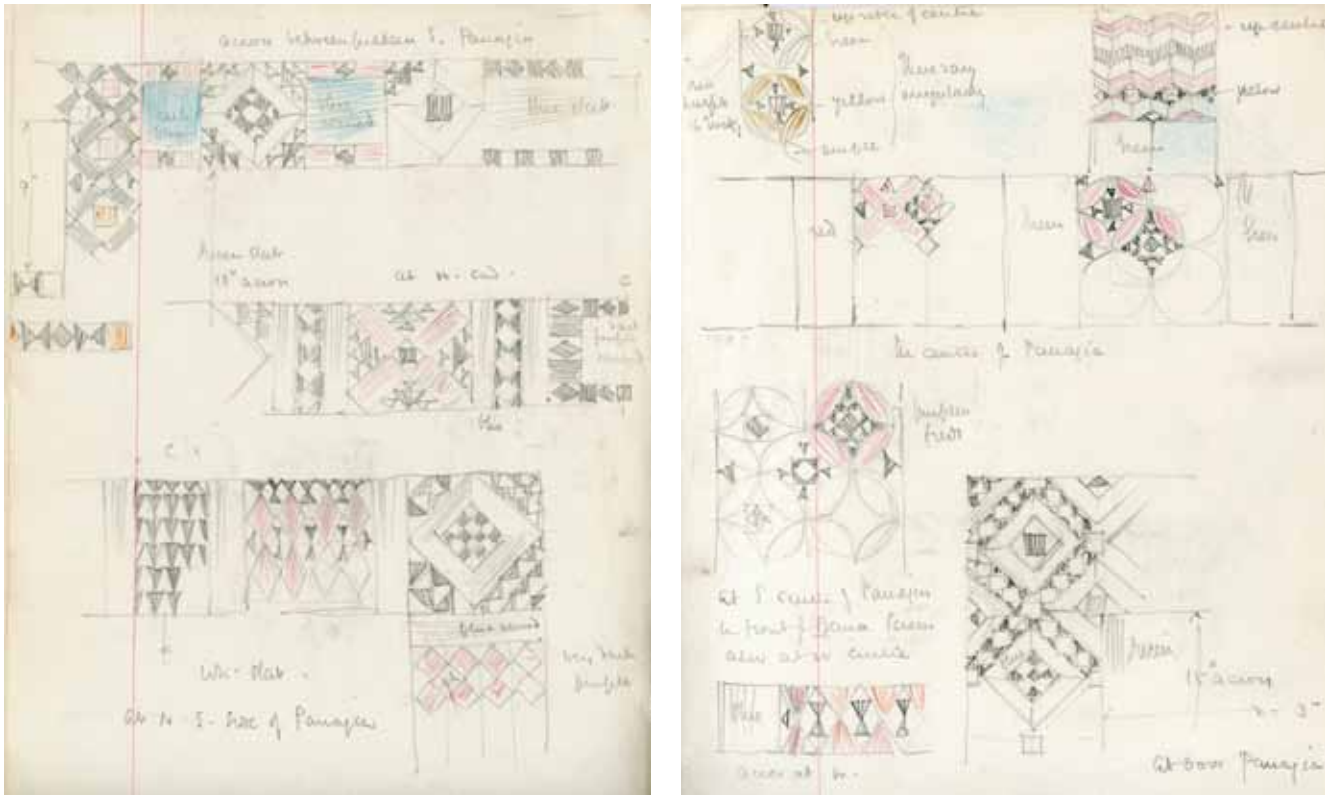


Plate 8a–b Annotated preliminary sketches of parts of the marble mosaic pavement, nave, Panagia church, Hosios Loukas monastic complex, Phocis, by Robert Weir Schultz and Sidney Howard Barnsley (*BSA BRF Archive*: Notebooks: SCH 13, 'Delphi, St Luke, Athens, Daphne', November 1889)

reproductions and photographs of the monument's art and architecture from the approximate 150 drawings and 48 photographs that the two architects produced for Hosios Loukas.[43] Although Diehl is praised in the introduction for his scholarly qualities, it is clear that both the aims and the guiding principles of their research were much different.[44] They recorded not only the architecture and the decoration, but even the liturgical vessels, various items of metalwork as well as the iconostasis in an attempt to offer the reader an overall view of the monument's art.[45]

Particular emphasis was placed on the documentation of the mosaics which covers almost a third of the recorded material. Details of the ornament in the arches, continuous floral and geometric motifs, as well as detailed colour drawings of the marble pavement of the Panagia church, one of the two main churches of the monastic complex, were reproduced for the first time in colour plates based on sketches that the two architects created on the spot (**Pl. 8a–b**).[46] Detailed technical remarks, almost entirely absent from Diehl's publication, cover two pages in the book with particular emphasis on the composition, the colour/tone and the method of fixing the tesserae.[47] Diehl's comparatively short descriptions and exhaustive enumeration of all possible iconographic parallels is supplemented in the book by a comprehensive analysis of the iconography of each figure and scene based on observation as well as by comparisons of the mosaics' style and technique with those of the Daphni cycle.[48] Although their remarks were not always accurate, their methodology certainly reflects a different archaeological approach: close *in situ* study of the decoration, detailed records in constantly updated notebooks, the production of preliminary drawings and sketches –that they would later colour and ink in London – usually with measurements and brief annotations, and the production of photographs.

Towards the end of their trip Weir Schultz and Barnsley headed to Thessaloniki where they had been requested to evaluate the damage done to the city's monuments by the fire of 1888. Fascinated by the Byzantine remains in the then still Ottoman city, they managed to record some of the monuments and their surviving decoration. Sadly, because of constraints of time and finance, they were only able to produce preliminary drawings and a limited number of photographs. The work initiated by Weir Schultz and Barnsley was to be continued two decades later by two younger architects: Walter Sykes George, Soane Medallist of the Royal Institute of British Architects and former student of the Royal College of Art, who arrived for the first time in 1906 and William Harvey, a Gold Medallist of the Royal Academy who commenced work in 1907.[49] With the support of the newly founded Byzantine Research and Publication Fund, both returned on different occasions to Thessaloniki from after 1908 to roughly until its liberation in 1912/13 to contribute to each others work on the city's Byzantine monuments.

Harvey was the first to record some of Thessaloniki's Byzantine churches. However, he was soon despatched by the Fund to Bethlehem and Jerusalem to document the surviving Byzantine monuments of those two cities. Walter George took over the work and, having assembled the records of previous architects, devoted himself more intensely to the assignment. Initially he carefully developed Weir Schultz and Barnsley's preliminary observations, mainly on building facts by contributing new first hand

material, while maintaining a close correspondence with Weir Schultz who had been based in London since his return from Greece in 1890.[50] He then proceeded to the recording of the decoration. His documentation, which is based on Weir Schultz and Barnsley's methodology, reflects a different generation of archaeological attitudes. William Harvey, on the other hand, still seemed rather preoccupied by 19th-century preconceptions concerning the treatment of the monument and its art.

George focused on the Early Byzantine monuments of the city with mosaic decoration such as the churches of St George (the Rotunda), St Demetrios, St Sophia and the Panagia Acheiropoietos, all of which were closely studied and documented. Before devoting himself fully to the task he followed Weir Schultz and Barnsley's example in closely examining earlier studies with extensive references to these monuments, such as those by Texier and Pullan, Bayet, Salzenberg and Gourlay, which he double checked and corrected based on observations made on the spot.[51] In his recording of the Rotunda, which was the first of the churches to occupy him fully in early May 1907, George first added to Weir Schultz and Barnsley's notes taken in 1890.[52] He made insightful remarks on the architecture of the building and then went on to produce preliminary sketches of the mosaics, accurate sections showing their iconography and place inside the church, coloured drawings with ornamental details as well as a handful of photographs of the dome composition that supplemented Weir Schultz and Barnsley's photographic records.[53]

George would also double-check short remarks on the monument made by his tutor and mentor William R. Lethaby, promising to come back and re-examine the mosaic cycle which was still covered by thick whitewash.[54] Lethaby, a renowned architect of the period, demonstrated throughout his career a profound interest in Byzantine art and architecture.[55] His most influential publication, in collaboration with Harold Swainson, is devoted to the church of Hagia Sophia, Constantinople.[56] Lethaby was fascinated by the Byzantines' expertise in both building and decorative techniques, and he urges the reader to look carefully at their methods and attitudes even though the monograph itself appears to depend rather heavily on previous scholarship.[57] Lethaby and Swainson set off to Turkey in March 1893 to begin systematic fieldwork. On his journey to Constantinople, Lethaby must have had the opportunity to examine closely those Byzantine monuments of Thessaloniki with surviving mosaics, the medium that interested him most.

It was at Lethaby's instigation and advice that George undertook research on the rest of the city's churches under the supervision of the Fund . Besides the Rotunda, he collaborated closely in correspondence with Weir Schultz, producing in September and October 1909 detailed notes on the architecture and decoration in St Sophia and the Panagia Acheiropoietos respectively.[58] For St Sophia George created additional preliminary drawings of details of the mosaic frieze based on Weir Schultz and Barnsley's initial remarks.[59] Copied in his notebook of 1910 is a series of details of the continuous floral motifs that decorated the newly revealed mosaic cycle of the Panagia Acheiropoietos, which he later reproduced in his final inked drawings with no attempt to complete any of the missing parts.[60] Finally, his recording of the decoration in the two monuments included the production, in close collaboration with Harvey, of various sets of photographs both of details and/or distant interior views.[61] William Harvey would also produce for the St Sophia mosaics rather crude, large watercolour panels that, unfortunately, fail to reflect the actual impact of their iconography and style.[62] His strong interest in the medium, however, is evident in his monograph on the Church of the Nativity in Bethlehem to which he contributed the majority of the drawings. The study was published by the Fund in 1910 with R. Weir Schultz as editor and in collaboration with W.R. Lethaby, O.M. Dalton, H.A.A. Cruso and A.C. Headlam.[63]

At the time George and Harvey were working on the churches of Thessaloniki, growing scholarly interest in the field of Byzantine art and architecture awakened concerns about surviving Byzantine antiquities, which subsequently prompted the initiation of extensive restoration programmes by the Ottoman authorities.[64] The discovery in 1907/8 of a series of mosaics in the north inner aisle of the basilica of St Demetrios was greeted with excitement by specialists and triggered a series of publications.[65] The cycle occupied the spandrels over the seven arches in that part of the church, which did not survive the fire of 1917. The majority of the relevant studies, however, failed to offer a consistent archaeological record of the new discoveries. Petros N. Papageorgiou reproduced in his 1908 article poor quality photographic plates, mainly of the recently revealed Marian cycle, along with rough sketches of pieces of sculpture and a single colour drawing of the ornamental decoration in the church with few significant scholarly remarks.[66] The series of publications that was to follow had equally little to offer in providing a concise report on the new finds based on first-hand observation.[67]

Oreste Tafrali's two studies on the decoration of St Demetrios, which both appeared in 1909, rely heavily on textual sources and contain no plates at all.[68] Likewise, his two general studies on the topography and the character of Byzantine Thessaloniki contain either no images at all or scant visual material of bad quality.[69] Although Charles Diehl visited the city in 1909 and examined the monuments *in situ* collaborating closely with the French architects Henri Saladin and, mainly, Marcel le Tourneau for his publications, his studies, distinguished by a lack of archaeological detail, lend little confidence to his conclusions. Le Tourneau, who worked systematically on the Thessaloniki monuments between 1907 and 1909, producing aquarelles and photographs using the newly applied method of photogrammetry, contributed only low quality photographic plates to Diehl's study.[70] Their 1918 publication, in collaboration with Saladin, included exterior and interior views of the city's monuments, some architectural plans and a few aquarelles, with little emphasis on the mosaic decoration: only four aquarelles of the newly discovered scenes in the church of St Demetrios were included, while Saladin reproduced, mainly for the Rotunda, Texier's plans of disputed accuracy.[71] In his earlier general *Manuel* of Byzantine art, Diehl devotes a whole

Plate 9 Dedicatory inscription (actual size), north inner aisle, spandrel G, nave, St Demetrios basilica, Thessaloniki. Annotated drawing by Walter Sykes George, painted squeeze and watercolour, 33.8 x 53cm (*BSA, BRF Archive*: Drawings: BRF 01.01.07.313)

Plate 10 St Demetrios with prophet and donor (detail), north inner aisle, spandrel B, nave, St Demetrios basilica, Thessaloniki. Annotated drawing by Walter Sykes George showing the line that discerns newer work on the mosaic from the older, pencil and watercolour, 48.5 x 36cm (*BSA, BRF Archive:* Drawings: BRF 01.01.07.306)

chapter to the Thessaloniki mosaics where he reproduces le Tourneau's recordings of the St Demetrios and St Sophia cycles as well as photographs from the Millet archive on the architecture of the Acheiropoietos church and the decoration of the Rotunda.[72] A sole exception is Feodor E. Uspenskij's record that managed, with the assistance of Nicolas K. Kluge, photographer and painter of the Russian Archaeological Institute in Constantinople, to provide a detailed technical and archaeological record of the St Demetrios mosaics accompanied by good illustrations of approximately 15 photographic plates.[73]

In the same period Thessaloniki's Byzantine monuments attracted the lively interest of professional photographers. Fréderic Boissonnas, the Swiss photographer who for more than three decades systematically photographed the Greek cultural and natural landscape, documented the Rotunda, St Sophia and St Demetrios. In 1919 he produced a lavish edition with annotated heliogravures.[74] For the mosaic cycles, however, he produced only a few distant and close up sets, unfortunately all rather murky, since he did not have access to proper lighting facilities. Around the same time, August Léon, a member of the team of specialists that visited Thessaloniki in May 1913 at the instigation of the geographer Jean Brunhes, produced some rather poor quality photographs of the newly discovered scenes in the church of St Demetrios as well as of the dome mosaics in St Sophia which had recently been restored under the initiative of Charles Diehl.[75]

Walter George appears to have been familiar with the professional photographic recording of the Thessaloniki monuments that would soon start to appear as 'cartes-postales', a very popular trend in late 19th- and early 20th-century photography.[76] George would use them for scholarly purposes initiating, in fact, a similar methodology. He paid his first visit to the Rotunda in 1907. Of the detailed remarks he kept, the study of the mosaic cycle occupies the largest part. By checking technical details against professional photographs by Paul Zepdji, the famous Armenian photographer who was based in Thessaloniki (20 Vardari Street) and who was active in the Balkans from the middle of the 19th century, George tried to distinguish restoration from improvisation and reach safe conclusions on later alterations that distorted the actual perspective of the scenes.[77]

The progressive replacement of 19th-century artistic reproductions and replicas by mechanical recordings of the buildings and their decoration encouraged the use of photography as a means that could further support archaeological investigation. By the turn of the century a new type of traveller/scholar would arrive in the Mediterranean seaports carrying photographic equipment instead of the easel and the brush. From 1839 when the earliest proto-photographs (daguerreotypes) of Greece and its monuments appeared as engravings in publications to the development in the late 19th century of easier methods such as the dry plate and, later, the roll film in the newly invented light cameras by Kodak, Linhof or Zeiss, photography witnessed major aesthetic and technical changes allowing its use for diverse purposes.[78] Scholars such as Cabrol, Millet, Lampros, Diehl and Tafrali would soon realize the importance of the new medium in the development of archaeology as a scientific discipline although, in sharp contrast to George, they did not exploit it for their own purposes but rather preferred to continue illustrating their publications with overpainted photographic reproductions.

George's methodology, which depended upon a combined use of archaeological drawing, photography and *in situ* observation, is best illustrated in his recording of the St Demetrios basilica. When he first visited Thessaloniki, St Demetrios was still a mosque (Kasimie mosque). He recorded the architecture of the monument building on Weir Schultz and Barnsley's preliminary recordings and then, in 1908/9, proceeded to document the mosaics with an emphasis on the recently uncovered scenes. He produced 13 drawings and 7 photographs. William Harvey added to his documentation 10 more photographs of the inner north aisle mosaics.

Improving on Weir Schultz and Barnsley's technique George introduced a slightly altered method – the so-called 'painted squeeze'– that would lead him to more accurate reproductions and, subsequently, conclusions. The method consisted of laying and pressing dampened blotting paper against the tesserae. Although he did not fully succeed in catching the sharp impression of the medium, the method

was definitely more advanced. George created the squeeze in a few instances only, mainly for the inscriptions of the Marian cycle (**Pl. 9**).[79] For the same cycle he produced watercolour drawings and photographs which clearly indicate that these belong to two phases: before and after the severe fire, probably during the 7th century, which destroyed a large part of the church. The subsequent extensive restoration that further enhanced the building's capacities and grandeur as a pilgrimage destination was discussed, more or less accurately, by most of the previous scholarship on the monument. However, *in situ* observation in the rare cases when this was made was not fully documented.[80] The value of George's record lies in the fact that he managed for the first time to offer a complete, true picture of the non-surviving scheme. In selective watercolour drawings of the group a line discerning newer work from the older is clearly marked (**Pl. 10**).[81] George also recorded his observations on the spot in detailed technical notes which concerned the laying, colour, texture and quality of the tesserae that seemed to differ considerably in the two phases. Five principal remarks were made.[82]

Evident in his records is his genuine concern for accurate documentation with particular emphasis on matters of technique. This approach was deeply rooted in his Arts and Crafts education. Trained under leading members of the Arts and Crafts movement such as Lethaby, who moved in the same cycles as William Morris and Phillip Webb, the architects of the Fund were all introduced to a specific philosophy and artisan techniques that had a profound impact on their careers. It was on Lethaby's advice that Weir Schultz was first dispatched to Greece and the Near East for a first-hand view of Byzantine architecture, then George to Thessaloniki and Harvey to Jerusalem and Bethlehem to work on the Byzantine monuments of the Near East.[83]

Central to the movement's aesthetic and ideas was the reaction against the eclectic revival of historical styles, especially the 'academic' and the 'classical' as well as the strong sense of craftsmanship, the unity of the intellectual designer and the craftsman.[84] A detailed study of medieval architecture was considered essential for an Art and Crafts architect in order to attain first-hand working knowledge of the building materials and techniques.[85] It was largely from this motivation that Lethaby urged his younger colleagues to undertake their research trips. They in return would use their hard-earned knowledge in future building projects. Weir Schultz was commissioned in 1906 to build the Anglican Cathedral at Khartoum, a mixture of local materials and Byzantine building techniques.[86] Barnsley designed and built the Church of the Wisdom of God in Lower Kingswood (consecrated in July 1892), one of the earliest manifestations of the Arts and Crafts version of Byzantium.[87] At the same time, the universal preference for decorative values, mostly the vertical and elongated architectural ornament, as well as a slightly unfinished effect (*non finito*), were among the principal ideas of the movement's artistic ideals.[88]

Both melded perfectly with key concepts of Byzantine art and aesthetics. Leading Arts and Crafts members, such as John Ruskin, William Morris, Phillip Webb, the painter Edward Burne-Jones and the architect John Francis Bentley gradually developed a very keen enthusiasm for it.[89] Mosaics were especially regarded by the pioneers of the movement who admired them as the essential Byzantine technique and frequently turned to them as a source of inspiration for their own projects. When Morris saw Fossati's drawings on the mosaic decoration of the Hagia Sophia (available from 1852) he remarked that they were: 'Nothing more beautiful than the best Byzantine art has ever been produced by man.'[90] His close friend Lethaby, in his joint publication on that church with Swainson in 1894, praises the monument and its decoration as the most interesting building on the surface of the earth.[91]

In an era when architects and artists such as Couchaud, Texier and Pullan, Durand or le Tourneau recorded inconsistently and at random surviving Byzantine monuments in Greece, British architects of the Byzantine Research and Publication Fund proceeded to a more comprehensive *in situ* study and documentation of both the architecture and the decoration of key Byzantine monuments of the Greek mainland and islands. Educated in and inspired by the Arts and Crafts tradition, Weir Schultz, Barnsley, George and Harvey contributed a unique approach to the largely unprofessional late 19th- and early 20th-century scholarship on Byzantine monuments with their particular emphasis on the mosaic, which had been rather neglected in earlier studies. Instead of publishing their records as part of a larger art-historical study, a common practice in the period's scholarship as the art histories of Bayet, Didron or Millet suggest, they made great efforts to raise the necessary funds in order to produce lavish monographs for each of the recorded monuments. Both scholarly quality and academic accuracy do not always characterize the produced result. However, their methodology was advanced for its time and their records have proved among the most valuable for the modern scholar.

Acknowledgements

I am indebted to Professor Liz James and Professor Maria Vassilaki for inviting me to contribute this paper to the present volume. Professor Robin Cormack and Amalia Kakissis, Archivist of the British School at Athens, helped with their most insightful comments at various stages to this research. I am grateful to them all.

Abbreviations

BSA, BRF Archive: British School at Athens, Byzantine Research Fund Archive

Notes

1 For a publication of the *Memorandum* see: H.-H. Russack, *Deutsche Bauen in Athen*, Berlin, 1942, 23; A. Papageorgiou-Venetas, *Haupstadt Athen: ein Stadtgedanke des Klassizismus*, Munich, 1994, 94.

2 For the two architects see: A. Kakissis, 'The Byzantine Research Fund Archive: encounters of Arts and Crafts architects in Byzantium', in M. Llewellyn-Smith, E. Calligas and P. Kitromilides (eds), *Scholars, Travels, Archives* (British School at Athens), Athens, 2009, 143–61, esp. 145–6.

3 For an examination of the cultural and social personae of the Dilettanti's membership in relation to the development of archaeology see: B. Redford, *Dilettanti: the Antic and the Antique in Eighteenth-century England* (J. Paul Getty Museum: Getty Research Institute), Los Angeles, 2008, 53–64; J.M. Kelly, *The Society of the*

Dilettanti: Archaeology and Identity in the British Enlightenment, New Haven, 2009.

4 For the revival of Greek Philhellenism and Romanticism see: C. Güthenke, 'Translating Philhellenism: comments on the movement of a movement', in E. Konstantinou (ed.), *Ausdrucks–formen des Europäischen und internationalen Philhellenismus von 17.–19. Jahrhundert* (Philhellenische Studien 13), Frankfurt, Berlin, Brussels, New York, Oxford, Vienna, 2007, 181–9, esp. 181–2; G. Tolias (ed.), *British Travellers in Greece 1750–1820* (exh. cat.), London, 1995, 10–21; E. Angelomatis-Tsougarakis, *The Eve of Greek Revival: British Travellers' Perceptions of Early 19th-century Greece*, London, 1990, 3–4; F.-M. Tsigakou, *The Rediscovery of Greece: Travellers and Painters of the Romantic Era*, London, 1981, 71; F.-M. Tsigakou and A.-S. Dollinger, *Glanz der Ruinen: die Wiederentdeckung Griechenlands in Gemälden des 19. Jahrhunderts aus den Beständen des Benaki Museums, Athen, und des Rheinischen Landesmuseums* (Kataloge des Rheinischen Landesmuseums Bonn; Bd. 4), Bonn, 1995; F.-M. Tsigakou, *Through Romantic Eyes: European Images of 19th-century Greece from the Benaki Museum,* Athens, 1996.

5 See the standard editions by S.-H. Weber, *Voyages and Travels in the Near East during the 19th Century*, Princeton, 1952, and L. Droulia (ed.), *On Travel Literature and Related Subjects, References and Approaches*, Athens, 1993. See also: Tolias (n. 4), 23 with select bibliography, and I. Vingopoulou, 'The Greek world as seen by travellers, 15th–20th centuries', in L. Navari (ed.), *Greek Civilization through the Eyes of Travellers and Scholars,* Athens, 2003, 28–62, esp. 54–5 with references to 19th-century travellers such as R. Curzon, R. Burgess and J.-J. Best who demonstrated renewed interest in Byzantine Greece as well as *The Rediscovery of Greece 1979*, mainly the Introduction where R. Chandler and G. Wheler are mentioned.

6 K. Kourelis, 'Early travellers in Greece and the invention of medieval architectural history', in D. Medina-Lasansky and B. McLaren (eds), *Architecture and Tourism: Perception, Performance, Place*, Oxford, 2004, 37–52, esp. 42–4; A. Cameron, 'The use and abuse of Byzantium: an essay on reception', in *Changing Cultures in Early Byzantium,* (Variorum selected series no. XIII), Aldershot, 1992, 3–31, esp. 20–2.

7 Tsigakou 1981 (n. 4), 71–2 and 148, and M. Nystazopoulou-Pelekidou, 'Byzantine Historicism in Greece: from Spyridon Zambelios to Dionysios Zakynthinos', in N.G. Moschonas (ed.), *Memory of D.A. Zakynthinos* (National Hellenic Research Foundation, Institute of Byzantine Research: Symmeikta no. 9), vol. II, Athens, 1994, 154–76, esp. 155–9.

8 E. Jeffreys, J. Haldon and R. Cormack, 'Byzantine studies as an academic discipline', in E. Jeffreys, J. Haldon and R. Cormack (eds), *The Oxford Handbook of Byzantine Studies*, Oxford, 2008, 3–20, esp. 10–11.

9 J.-B. Bullen, *Byzantium Rediscovered,* London, 2003, 5–9.

10 On the foundation of the Greek and foreign archaeological schools in Greece see: C. Fitschen, 'Archaeological investigation in Greece during the times of king Otto (1832–1862)', in *Athens-Munich: Art and Culture in Modern Greece* (exh. cat., National Gallery of Art-National Historical Museum), Athens, 2000, 213–28, esp. 222–5.

11 On the formation of the BRF Archive see: Kakissis (n. 2), esp. 143–4.

12 C. Mango, 'Editor's preface', in D.V. Ainalov, *The Hellenistic Origins of Byzantine Art* (trans. E. Sonolevitch and S. Sobolevitch, ed. C. Mango), New Brunswick, 1961, 7–15, esp. 7–9 on the so-called 'Roman School' exemplified mainly by the works by Wickhoff, Kraus, Riegl and Rivoira.

13 These were originally published in: *Aya Sofia, Constantinople as recently restored by order of H.M. the Sultan Abdul Medjid from the original drawings by Chevalier Gaspard Fossati, lithographed by Louis Haghe Esq.*, London, 1852, and followed first in a series of reproductions by W. Salzenberg, *Altchristliche Baudenkmale von Konstantinopel von V. bis XII Jahrhundert*, Berlin, 1854, and then by foreign and Greek scholars such as Bayet (C. Bayet, *L'art byzantin*, Paris, 1904, 32, fig. 12), Lambros (S. Lambros, *Illustrated History of Greece from the Ancient Times until the Fall of Constantinople*, Athens, 1902, vol. III, 624) and Mavroyannis (G. Mavroyannis, *Byzantine Art and Artists*, Athens, 1893, 46, fig. 5) to mention only a few.

14 A. Couchaud, *Choix d'églises byzantines en Grèce,* Paris, 1842.

15 See for example: C. Texier and R. Popplewell-Pullan, *Byzantine Architecture: Illustrated Examples of Edifices erected in the East during the Earliest Ages of Christianity with Historical and Archaeological Descriptions*, London, 1864, pl. 16 (on the mosaic pavement of St Sophia, Trebizond), pl. 26 (on the mosaics of St Demetrios, Thessaloniki), pls 30–4 (on St George the Rotunda, Thessaloniki) and pl. 40 (on the dome mosaics of St Sophia, Thessaloniki).

16 A. Lenoir, *Monuments de l'ère chrétienne: Instructions à l' usage des voyageurs en Orient*, Paris, 1856.

17 See for example: A.N. Didron, *Iconographie chrétienne: histoire de Dieu*, Paris, 1843, pl. 20 and pls 102–3.

18 C. Bayet, *L'art byzantin*, Paris, 1883, 8.

19 C. Bayet, *Recherches pour servir à l'histoire de la peinture et de la sculpture chrétienne en Orient avant la querelle des iconoclasts* (Bibliothèque des Écoles Francaise d' Athènes et Rome no. 10), Paris, 1879, 91–3.

20 Dedicated to their research trip in Italy are parts of notebooks *BSA BRF Archive*: Notebooks: SCH 1; SCH 4; SCH 6. For the drawings they produced see: *BSA BRF Archive:* BRF 01.05.03.003 (for S. Vitale), BRF 01.05.02.002 (for the Florence Baptistery), BRF 01.05.01.004, 006, 007, 010 and 011 (for S. Marco).

21 E. Caron, *Les mosaiques et les peintures de la mosquée de Kahrié Djami à Constantinople* (Bulletin Monumental), Paris, 1886, and A. Leval, *Catalogue explicatif des principales mosaiques, peintures et sculptures: existant à Kahrié-Djami à Constantinople et photographiées par Pascal Sébah*, Constantinople, 1886, in *BSA BRF Archive*: Notebooks: BAR 4 (1890), D. Salazaro, *Studi sui Monumenti della Italia meridionale dal IV° al XIII° secolo* (L'Arte Romana al Medio Evo: appendice agli Studi sui Monumenti della Italia meridionale), Naples, 1871–81 (86) and H.-B. de Jouy, *Les mosaiques chrétiennes des basiliques et des églises de Rome*, Paris, 1857, in *BSA BRF Archive*: Notebooks: BAR 5 (1890), G.-B. de Rossi, *Mosaici cristiani e saggi dei pavimenti delle chiese di Roma anteriori al secolo XV,* Rome, 1872, C. Diehl, *Ravenne: études d'archéologie Byzantine* (Bibliothèque d'art ancien), Paris, 1886, and J.-P. Richter, *Die Mosaiken von Ravenna: Beitrag zu einer kritischen Geschichte der altchristlichen Malerei*, Vienna, 1878 in *BSA BRF Archive*: Notebooks: SCH 11 where a full reading list of the Byzantine titles they consulted is supplied.

22 Bayet (n. 18) and Lenoir (n. 16) in *BSA BRF Archive*: Notebooks: BAR 5 (1890).

23 R. Weir Schultz and S.-H. Barnsley, *The Monastery of Saint Luke of Stiris, in Phocis, and the Dependent Monastery of Saint Nicholas in the Fields, near Skripou, in Boeotia*, published for the Committee of the British School at Athens, London, 1901, 7.

24 For Texier and Pullan (n. 15), see *BSA BRF Archive*: Notebooks: BAR 7 and SCH 9 1889. For the drawings they copied from Couchaud (n. 14), see for example: *BSA BRF Archive:* BRF 01.01.01.075 and BRF 01.01.01.253 and 254.

25 See for example C. Diehl, *L'église et les mosaïques du couvent de Saint-Luc en Phocide* (Bibliothèque des écoles françaises d'Athèns et de Rome, fsc. 55), Paris, 1889, and G. Lambakes, *Christian Archaeology of the Daphni Monastery (Christianiki Archeologia tis Monis Daphniou)*, Athens, 1889. Large extracts from both publications are copied in *BSA BRF Archive*: Notebooks: SCH 12 and BAR 4 dated in November 1889 and April 1890 respectively.

26 Lambakes, a key figure in Byzantine archaeology in Greece, who served as the personal secretary of Queen Olga since 1885, was the founder of the Byzantine and Christian Museum in Athens. During his research trips he produced a vast photographic archive of major Byzantine monuments of the Mediterranean see: D. Konstantios, *The History of the Christian Archaeological Society (Istoria tis Christianikis Archaiologikis Etereias)*, Athens, 2009, 29.

27 *BSA BRF Archive:* BRF 01.01.01.164-189 and *BSA BRF Archive:* BRF 02.01.01.055-85 and BRF 02.01.01.090-095, Barnsley appears to have been behind the lens in the majority of instances.

28 For an intriguing history of the image see: R. Cormack, 'Rediscovering the Christ Pantokrator at Daphni', *Journal of the Warburg and Courtauld Institutes* 71 (2008), 55–74.

29 G. Lambakes, *The Monastery of Daphni after Restoration (I moni Daphniou meta tis episkeyes)*, Athens, 1899, 43.

30 Severely damaged episodes were identified, the number of figures in the narrative scenes was corrected, partly erased inscriptions were read and transcribed see: *BSA BRF Archive*: Notebooks: BAR 4 (10 January 1890 to 2 April 2 1890).

31 Lambakes (n. 25), 99, 106–7. For the original drawings of the east apse see: *BSA BRF Archive:* BRF 01.01.01.195–198, nos 195 and 196

dated 29/04/1888 and 28/04/1888 respectively, no 198 dated April 1890.

32 See mainly *BSA BRF Archive:* BRF 01.01.01.164 (dated 28/04/1889), 165, 166 and BRF 01.01.01.173 and 176, see also *BSA BRF Archive*: Notebooks: SCH 5 where preliminary drawings of the mosaic borders of the Daphni cycle were created dated 25 April 1888.

33 *BSA BRF Archive*: Notebooks: SCH 12, dated November 1889.

34 *BSA BRF Archive:* 3d-objects: Mosaic 'swatch' and Plaster wall-pieces.

35 Maybe the most representative example is the drawing depicting the Prophet Ezekiel: see *BSA BRF Archive:* BRF 01.01.01.187.

36 The phrase belongs to the Greek 19th-century writer Yannis Kampisis: see, E.D. Mathiopoulos, 'A study of the collection of Byzantine replicas', in O. Gkratziou and A. Lazaridou (eds), *From the Christian Collection to the Byzantine Museum (1884–1930)* (exh. cat., Byzantine and Christian Museum), Athens, 2009, 77–115, esp. 86–7, where the practice is extensively analyzed and discussed; see also: Cormack (n. 28), 67–8.

37 G. Millet, *Le monastère de Daphni: histoire, architecture, mosaïque* (Monuments de l'art byzantin, no 1), Paris, 1899.

38 See the detailed analysis in Mathiopoulos (n. 36), 83–8.

39 Millet (n. 37), pls 7–19.

40 Ibid., Preface 11, 67, fig. 39 and 68, n. 7.

41 Diehl (n. 25).

42 *BSA BRF Archive*: Notebooks: BAR 2 (10 August 10 1890) and BAR 4 (10 January 1890–5 April 1890).

43 Diehl (n. 25), 35, fig. 1, 36, fig. 2, 37, fig. 3. Diehl himself regrets in his 1897 publication on the Byzantine mosaics of St Luke for not having included enough images to his initial (1889: n. 25) publication of the monument's mosaic cycle that 'would have helped the reader appreciate their artistic value and decorative character': *Mosaïques Byzantines de Saint-Luc* (Monuments et mémoires publiés par l'Académie des Inscriptions et Belles-Lettres (Deuxième fascicule du tome III), Paris, 1897, 3.

44 Weir Schultz and Barnsley (n. 23), 1901, 2, n. 3.

45 Ibid., 31, 38–42.

46 Ibid., pls 30–55 of the publication are devoted to the meticulous recording of the monument's *opus sectile* pavement and mosaics. For the original drawings of the Panagia church pavement see *BSA BRF Archive*: BRF 01.01.04.130 and 132-135 see also the preliminary sketches in *BSA BRF Archive*: Notebooks: SCH 13 dated November 1889.

47 Ibid., 42–3.

48 Both monographs seem to lay particular emphasis on the study of the mosaic cycle to which they devote their third part (Diehl [n. 25], 39–72 and Weir Schultz and Barnsley [n. 23], 42–66).

49 For the two architects see: Kakissis (n. 2), 155–7.

50 Ibid., 154, n. 53.

51 Texier and Pullan (n. 15), Bayet (n. 18), Salzenberg (n. 13), and C. Gourlay, 'The minor Byzantine churches of Constantinople', *Journal of the Royal Institute of British Architects 14* (1907), 637–49, no. 18.

52 Weir Schultz and Barnsley's original notes on the Thessaloniki monuments as well as those by George were transcribed in October 1932 by the architect A.H.S. Megaw the newly appointed Macmillan student and later Assistant and Acting Director of the British School. Megaw, who arrived from Cambridge in Athens in 1930 to assume at Weir Schultz's instigation research on the key Byzantine monuments of the Greek mainland, was discussing with Weir Schultz the possibility of reviving the researches of the Fund.

53 For George's original remarks see: *BSA BRF Archive*: Annotated transcripts and Notes 'Church of St George Rotonda, Salonika', for his preliminary sketches of the mosaic cycle: *BSA BRF Archive*: Notebooks: GEO 1, for his drawings *BSA BRF Archive*: BRF 01.01.07.192, 197 and BRF 01.01.07.201-204, for the photographs he produced see: *BSA BRF Archive*: BRF 02.01.07.071-73.

54 Lethaby's short remarks have also been transcribed by Megaw see: *BSA BRF Archive*: Annotated Transcripts and Notes 'St George, Salonika, Notes W.R.L.'.

55 On Lethaby and his involvement with the British School Fund see mainly: Kakissis (n. 2), 146–7.

56 W.R. Lethaby and H. Swainson, *The Church of Santa Sophia, Constantinople: a Study of Byzantine Building*, London, 1894.

57 For the two architects and their monograph see: Bullen (n. 9), 168–73.

58 For George's notes on the church of St Sophia see: *BSA BRF Archive*: Notebooks: GEO 3 (dated 7 September 1909). These were transcribed, along with Weir Schultz's original notes on the same monument, by Megaw in 1932: *BSA BRF Archive*: Annotated Transcripts and Notes, 'St Sophia, Salonika' (dated 13 October 1932). George's original notes on the Acheiropoietos church were also transcribed by Megaw in 1932: *BSA BRF Archive*: Annotated Transcripts and Notes, 'Eski Djouma, Salonika' (dated 6 October 1909).

59 For George's drawings of the St Sophia mosaic frieze see mainly: *BSA BRF Archive*: BRF 01.01.07.092.

60 For the preliminary drawings see: *BSA BRF Archive*: Notebooks: GEO 2 (dated 1910). For the final inked versions see: *BSA BRF Archive*: BRF 01.01.07.018 and 19.

61 For George's photographs of the St Sophia mosaics see: *BSA BRF Archive*: BRF 02.01.07.104 and BRF 02.01.07.130–133, for those by Harvey for the same monument: *BSA BRF Archive*: BRF 02/01/07/121-129 both sets supplement Weir Schultz and Barnsley's photographic records of the monument. For their photographs of the Panagia Acheiropoietos church see: *BSA BRF Archive*: BRF 02.01.07.004-7.

62 For Harvey's St Sophia watercolours see: *BSA BRF Archive*: BRF 01.01.07.091, 92, 95, 98, 99, 100. These were reproduced in March–April 1923 (*BSA BRF Archive*: BRF 01.01.07.094, 96, 97, 101, 102) by the stained glass artist Joan Fulleylove who must have also worked at the Anglican Cathedral in Khartoum commissioned in 1906 by Weir Schultz; for Fulleylove, see: P. Cormack (ed.), *Stained Glass Artists of the Arts and Crafts Movement*, London, 1985, 9, for Khartoum Cathedral; D. Ottewill, 'Robert Weir Schultz (1860–1951): an Arts and Crafts architect', *Architectural History* 22 (1979), 88–115, esp. 104–7, and Cormack (n. 28), 62, n. 19.

63 R. Weir Schultz (ed.), *The Church of the Nativity at Bethlehem*, in collaboration with W.R. Lethaby, O.M. Dalton, H.A.A. Cruso and A.C. Headlam, illustrated by W. Harvey (Byzantine Research Fund in association with the British School at Athens), London, 1910.

64 C. Mavropoulou-Tsioumi and K. Theocharidou-Tsaprali, *The Restoration of Byzantine and post-Byzantine Monuments of Thessaloniki (I anastilosi ton Byzantinon kai metabyzantinon mnhmeion tis Thessalonikes)*, Athens, 1985, 8–9, 12–17.

65 For the most comprehensive study to date of the mosaic cycle of the monument which was discovered in the late 1900s see: R. Cormack, 'The mosaic decoration of St Demetrios, Thessaloniki: a re-examination in the light of the drawings of W.S. George', *Annual of the British School at Athens* 64 (1969), 16–52.

66 P.N. Papageorgiou, 'Thessaloniki monuments dedicated to the worship of the holy martyr Demetrios (Mnhmeia tis en Thessaloniki latreias tou megalomartyros Hagiou Demetriou)', *Byzantinische Zeitschrift* 17 (1908), 321–81, pls 1–4 (for the photographs), 5 and 6 (for the coloured drawings of the mosaics).

67 Equally poor on the documentation of the Thessaloniki mosaic cycles seem to have been earlier publications devoted to the issue, see for example: J. Kurth, 'Die mosaikinschriften von Salonik', *Athenische Mitteilungen* 22 (1897), 463–73.

68 O. Tafrali, *Sur les réparations faites au VIIe siècle à l'église de Saint-Démétrius de Salonique* (Extrait de la Revue Archéologique), Paris, 1909; O. Tafrali, *Sur la date de l'église et des mosaiques de Saint-Démétrius de Salonique* (Extrait de la Revue Archéologique), Paris, 1909.

69 O. Tafrali, *Thessalonique au quatorzième siècle*, Paris, 1913; O. Tafrali, *Topographie de Thessalonique*, Paris, 1913: both reproduce general photographs of the city and its monuments as well as one photographic plate of the interior of the Panagia Acheiropoietos church (pl. 15.1), one general view of the St Demetrios interior (pl. 15.2) and two photographic plates of the Marian cycle (pl. 14).

70 C. Diehl and M. le Tourneau, *Les mosaiques de Saint-Démétrius de Salonique* (Académie des inscriptions et belles-lettres, Commission de la Fondation Piot, Monuments et mémoires, vol. 18 (1910–11), Paris, 1911, pls 16–21; le Tourneau was among the first to present images from St Demetrios to the Paris Salon of 1906 attracting the interest of the broader French public, artists and scholars. The newly launched (in the mid-19th century) method of photogrammetry was in fact a practice of determining the geometric properties of objects from photographic images.

71 C. Diehl, H. Saladin and M. Le Tourneau, *Les monuments chrétiens de Salonique* (Monuments de l'art byzantin 4), Paris, 1918, ch. I (St George, the Rotunda), 19–31, fig. 1 (plan of the church reproduced from Texier), figs 3 and 4 (photos of the mosaics in the vaults), pls 1 and 2 (the dome mosaics); ch. II (Panagia Acheiropoietos), 35–58, figs 5–30 (exterior and interior photographic reproductions), figs 21–7 (photographs of the mosaics), pls 3–12 (architectural plans, aquarelles); ch. III (St Demetrios), 61–115, figs 28–44 (exterior and interior photographic plates), figs 45–8 (details of the mosaic cycle, including only two photographs with details of the Maria cycle), pls 13–34 (architectural plans and aquarelles, including four aquarelles of the Maria cycle and the pillar mosaics); ch. IV (St Sophia), 117, figs 49–54 (exterior and interior photographic reproductions), figs 57–67 (photographic plates with details of the mosaic cycle), pls 35–49 (architectural plans, sketches of architectural members, two aquarelles of the mosaic cycle and two photographic plates of the decoration in the dome).

72 C. Diehl, *Manuel d'art byzantin*, Paris, 1910, see: figs 91–4 and 169 (for le Tourneau's recordings of the St Demetrios Marian cycle), fig. 170 (for St Sophia), figs 53 and 57 (for Millet images of Panagia Acheiropoietos and of St George).

73 For a comparative analysis of the Greek, French and Russian scholarship on the Thessaloniki monuments see mainly: Cormack (n. 65), 17–19.

74 F. Boissonnas, *Salonique, la ville des belles églises*, Geneva, 1919, pls 14–15 (for the Rotunda), pls 25–36 (for St Demetrios), pls 37–9 (for St Sophia).

75 See G. Velenis, 'Thessaloniki monuments in the photographs of the Albert-Kahn museum (Ta mnhmeia tis Thessalonikis stis autochromies tou Mouseiou Albert-Kahn)', in *Thessaloniki: les autochromes du Musée Albert-Kahn*, Athens, 1999, 125–45, esp. 125–8 (St Demetrios), 128–35 (for St Sophia). For an exhibition of some of this material see: J. Beausoleil *et al.* (eds), *1913–1918 Θεσσαλονίκη. Οι τύχες των Βαλκανίων (1913–1918 Thessaloniki: the Destiny of the Balkans)* (exh. cat., Benaki Museum, Athens, 1999, 16–17 (for St Sophia), 17–18 (for St Demetrios).

76 For the trend as far as Thessaloniki is concerned see: E. Kitsis, *Cartes-postales of Thessaloniki at the Beginning of the 20th century (Cartes-postales tis Thessalonikes stis arxes tou 20ou aiona*), Thessaloniki, 2008.

77 George's original notes on the St Demetrios church (dated 1908) were also transcribed by Megaw in 1932 see: *BSA BRF Archive:* Annotated Transcripts and Notes, 'St Demetrius, Salonika' (dated 13 October 1932). The BRF Archive photographic collection includes professional sets by the same photographer of the interior of the St Demetrios church see: *BSA BRF Archive*: BRF 02.01.07.144.

78 G. Edwards, 'Foreign photographers in Greece in the 19th century', in *Photography in the 20th Century* (exh. cat., Benaki Museum), Athens, 1985, 14–24, esp. 17, 20, 23–4, reprinted as F. Constantinou and A Tsipralou (eds), *Athens 1839–1900: A Photographic Record*, Athens, 2003.

79 Cormack (n. 65), pl. 7b; R. Cormack, *The Church of St Demetrios: the Watercolours and Drawings of W.S. George* (exh. cat., Vafoloulio Cultural Centre), Thessaloniki, 1985, 108–16, nos 31, 33, 35, 37, 38, 39; for the original watercolour 'squeeze' drawings see: *BSA BRF Archive*: BRF 01.01.07.307, 310, 311, 313, 314, 315.

80 For a detailed analysis of the history of the monument see: Cormack (n. 65), 18–19. For a critical re-evaluation of all the previous literature on the monument's archaeology and art see: Cormack 1985 (n. 79), 17–19.

81 See for example: Cormack (n. 65), pls 6–9 and 15; Cormack 1985 (n. 79), 74–7; for the original watercolour drawings see: *BSA BRF Archive*: BRF 01.01.07.306, 308, 309, 312.

82 George's original notes on the mosaic cycle were transcribed in two A4 sheets by Megaw, who was planning to work on the church of St Demetrios, in October 1932 see: *BSA BRF Archive:* Annotated Transcripts and Notes, 'Mosaics of St Demetrius, Salonika' (dated 13 October 1932). The notes were first studied by O.M. Dalton, who was familiar with the work of the Fund. Dalton included a brief summary in his *Byzantine Art and Archaeology*, Oxford, 1911, 279, n. 1.

83 See: Kakissis (n. 2), 145–7.

84 William Lethaby in his fundamental *Architecture, Mysticism and Myth* (1891), encourages the architect to associate himself with draughtsmen in order to familiarize himself at first hand with various building techniques see: M. Greenstead (ed.), *An Anthology of the Arts and Crafts Movement*, London, 2005, 33–4 (2.4/I).

85 E. Cumming and W. Kaplan, *The Arts and Crafts Movement*, London, 2002, 9–15, esp. 15.

86 Cormack (n. 28), 62, n. 19.

87 Bullen (n. 9), 166–7, where the Byzantine features of the building are meticulously analyzed and discussed.

88 K. Livingstone, 'Origins and development', in K. Livingstone and L. Parry (eds), *International Arts and Crafts*, London, 2005, 14–16; R.P. Blakesley, *The Arts and Crafts Movement*, London, 2006, 7–9.

89 Bullen (n. 9), 164–8, where the impact of Byzantium on the development of the movement's aesthetics is discussed in detail.

90 Quoted by Rice in: D. Talbot Rice, *The Appreciation of Byzantine Art*, London, 1972, 30.

91 Bullen (n. 9), 173.

Chapter 26
The Christ Head at the Metropolitan Museum of Art, New York, the Apse in the Bode Museum, Berlin, and Other Fake Mosaics[1]

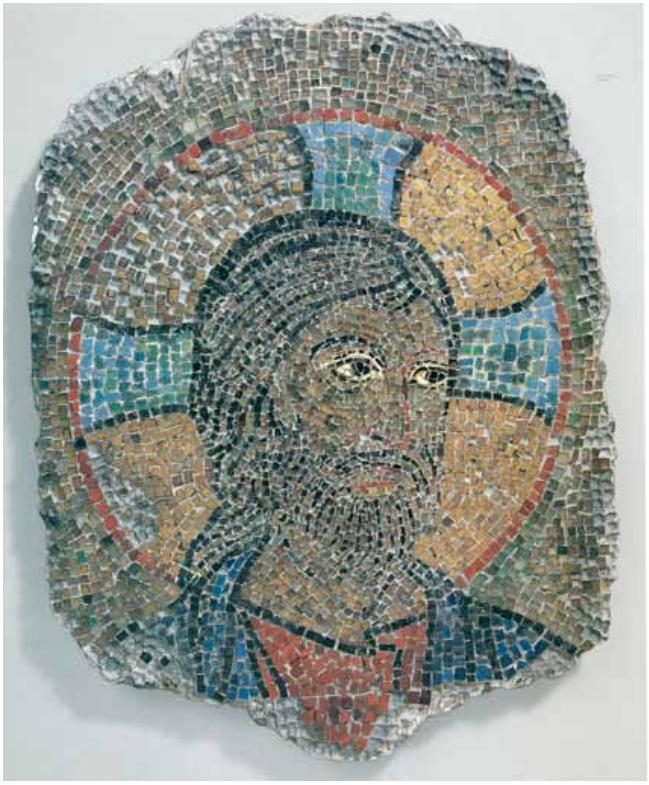
Irina Andreescu-Treadgold

One of the byproducts of the *Corpus for Wall Mosaics in the North Adriatic Area*, with which I have been involved since 1975, has been to establish a body of statistically significant examples for determining a mosaic's material characteristics, including its authenticity and whatever interventions it might have suffered.[2] This information has been acquired from numerous scaffoldings, chiefly in Venice and Torcello, but also in the other North Adriatic monuments decorated with wall mosaics during the Middle Byzantine period: Hagia Sophia in Istanbul, Ravenna during an earlier period, and Greece and Rome during several periods. Most of the illustrations for this text have been photographed on the scaffoldings raised in front of these mosaics.

In a recent article published in the volume *Byzantine Trade* edited by Marlia Mango,[3] I mentioned mosaic fakes displayed in museums and singled out two examples in a footnote:

> Fake mosaics are a sensitive issue even for important museums: a fake fragment with an idiosyncratic head of Christ has been exhibited for several years now in the Byzantine section of the Metropolitan Museum of Art…. In conversation, [the curator Helen] Evans informed me that some of the glass tesserae had been tested by the museum's laboratory and did not appear to be modern. I told her, however, that many other considerations were more significant than the antiquity of the mosaic's tesserae, which are its building-blocks but are also loose elements that can be procured individually. Among the red flags, on technical grounds alone, the modern setting bed is without justification, and so is the contrived pattern of missing tesserae that would "antique" the texture of the piece. Other oddities include faulty "grammar" in the execution of the gold background and the face and the unprecedented use of transparent "amber" glass as the main material for the flesh

Plate 1 The Jaharis Christ, Metropolitan Museum of Art, New York, on loan from Mary and Michael Jaharis



tones of the face and neck. Even more egregious is the case of the mosaic allegedly from the 6th-century apse of San Michele in Africisco, Ravenna, exhibited in the Museum für Spätantike und Byzantinische Kunst in Berlin, in reality a copy made in precisely 1850–1851 during a well-documented episode of Prussian collecting.

The two main examples discussed here are both on display in the main galleries of their respective museums and are presented as original mosaics. Their labels read as follows: 'Mosaic Head of Christ. Glass. Byzantine Made 1100–1200; 11⅜ x 8¼in. (28.9 x 20.9cm); Lent by Mary and Michael Jaharis' for the Metropolitan Museum (**Pl. 1**)[4] and 'Apsis mosaik aus San Michele in Africisco zu Ravenna, Ravenna zum 545/546, Mosaik aus Glas und Stein; H.432cm, B 615cm; 1843/44 für König Friedrich Wilhelm IV. erworben; 1903 durch Kaiser Wilhelm II. an das Museum überwiesen; Inv.-Nr. 6642' for the Bode Museum, Berlin (**Pl. 12**).[5]

Though the circumstances of the production of these artefacts were rather different, I am disturbed by the official stance of these two prestigious museums about their respective pieces: i.e., that they represent original mosaics from the years AD 545/6 and the period between 1100 and 1200, respectively. Though many museums – and private collections – have their share of fakes, including wall mosaics, most of these fakes are not given pride of place in the public exhibition spaces: in fact, most are not exhibited at all, and can be studied only in these museums' storage quarters.[6] I propose to consider each of the two pieces separately. My information on them was gathered at first hand.

I thank both Helen Evans, the Mary and Michael Jaharis Curator in the Medieval section at the Metropolitan Museum of Art, and Arne Effenberger, the then curator (later Director, now retired) of the Museum für Spätantike und Byzantinische Kunst at the Bode Museum in Berlin for making their respective pieces available for my examination. I examined the Jaharis Christ in 2005 and the Berlin apse first in 1988 during a trip across the Berlin Wall and then in 1992 after German reunification, during my tenure of a Fulbright Fellowship in 1992. In Berlin in 1992 I also benefited from a small scaffolding that allowed me to survey the mosaics at close quarters. In 2011, I revisited the archives in Berlin relevant to San Michele in Africisco and found from their log that since 1992 I had been the only user of these documents (their call number had traditionally been in the *Registratur der Koeniglichen Museen (Pars IX K) von Juni 1843 bis ult. Dezember 1904*; now this file is I/FBS 3). My thanks to Beate Ebelt of the Zentralarchiv, Staatliche Museen zu Berlin – Preußischer Kulturbesitz, for making the materials available expeditiously and for transcribing a difficult passage in German from the *San Michele in Africisco* dossier. At the time I shared with the curators at the Metropolitan Museum of Art and the Bode all the information I gathered from the examination of their pieces, and in the case of the Berlin mosaics I have already published two comprehensive articles, 16 years apart, specifically on the mosaics of San Michele in Africisco.[7]

The Jaharis Christ (Pl. 1)[8]

I did not succeed in determining the provenance of the Jaharis Christ, which has been on display since 2001 at the Metropolitan Museum of Art. Despite several attempts to discover the mosaic's commercial or other origins, I was never given any information on the matter at the museum's Medieval Department. In 2005, when trying to elucidate the piece's market history, I was also scolded in an email for my interest in such matters by a collector (who had claimed to know the [German?] gallery that had sold the piece to Mrs Jaharis).[9]

The panel has an irregular contour enclosing the head and part of the shoulders, and looks as if it has been lifted from a (narrative?) scene, probably from a Middle Byzantine Christological cycle, possibly a miracle or the Entry into Jerusalem, maybe a Harrowing of Hell (Anastasis). It contains only Christ's head in a three-quarter position looking to the viewer's right, with a section of his shoulders. A cross is inscribed in the halo around Christ's head; the head, the halo and the body are set against a golden background.

For this discussion, I have included a few original wall mosaics of comparable dates. Setting bed examples include a medieval fragment (12th century, with mid-19th century patching), now at the Brera in Milan and originally probably from Torcello's west wall (**Pl. 2**) and a fragment from the Stoudios monastery (**Pl. 3a–c**), dated towards the end of the 10th century. The two examples chosen for the iconography of Christ's figure in a position similar to that of the Jaharis piece are both *in situ* and dated around 1100, and can provide point by point comparisons: one is the Daphni Christ in the

Plate 2 Back of the panel of St Andrew, Pinacoteca di Brera, Milan

Plate 3a–c Mosaic fragment from Stoudios monastery, main section, cross section and back surface. Benaki Museum, Athens

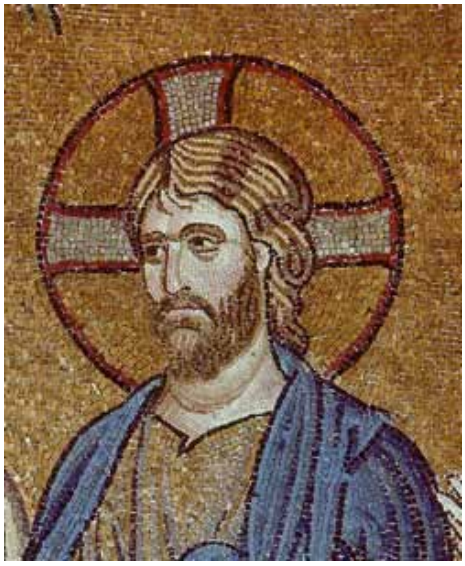


Plate 4a–b Partial view of Christ, The Entry into Jerusalem, Daphni monastery

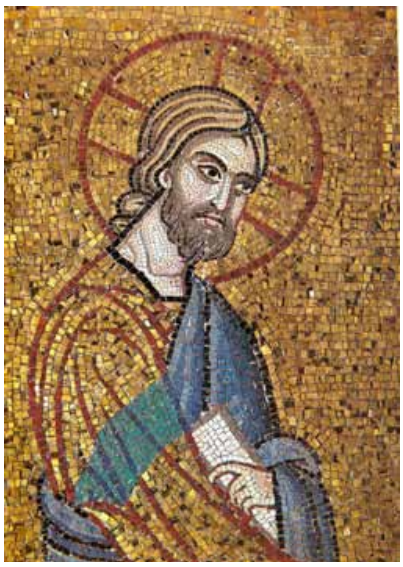


Plate 5 Detail of the Temptations of Christ, south vault, San Marco, Venice

Palm Sunday scene (**Pl. 4a–b**); another, from San Marco, Venice, is the Christ from the scene of the Third Temptation by the Devil (**Pl. 5**). For another, specific iconographic feature – the type of the cross around Christ's head, imperfectly imitated by the Jaharis Christ – I have taken two examples from the early 11th-century mosaics of St Sophia in Kiev (**Pl. 6a–b**).

Additional considerations about the modern and pre-modern restorations as well as their results will be presented in what follows in connection with each of the cases under discussion.

Some technical observations

The back of the Jaharis panel is uniform throughout and consists of a modern, artificial grey setting bed (resin?) of some sort, into which straw has been mixed. It is fitted over a rigid metal sheet, meant to allow it to be hung on the wall. There is no visible evidence that a real layer of an original setting bed is embedded behind that support. The same grey material is visible in the interstices between tesserae as well as where tesserae are missing on the panel's front. This is a crucial point that needs explaining: why were the tesserae set on a modern background? To answer the possible objection that the present setting bed, though entirely modern, has replaced an original one (now destroyed because the mosaic was lifted from a wall and reset on a setting bed different from its original, plaster one), let us look more closely at the mosaic itself.

The modern setting bed in the Jaharis Christ should of course be contrasted with the two medieval setting beds from the examples above, made of plaster. The modern piece, however, is not set up so as to indicate that its setting bed, which preserves no visible traces of plaster, is entirely new. On the contrary, some of the details we see, which were evidently meant to 'authenticate' the new piece, are misplaced overkill (that is, overzealous interpretations of features encountered in original mosaics, but out of place in this piece). Viewing the panel from the front, we notice the following technical points:

- the empty sockets, supposedly left by fallen tesserae, set or punched into the modern setting bed (which is the same throughout the entire piece, front and back). Many of these empty sockets are oval-shaped and have rounded corners (**Pl. 7a**), an impossible shape for a missing tessera (tesserae – as their name indicates – are overwhelmingly rectangular). Notice especially the sockets for the (allegedly missing) gold ground above the top of the head, and on the panel's right side, but also at

Plate 6a–b Christ representations with inscribed cross: Deësis and Christ the Priest, St Sophia, Kiev

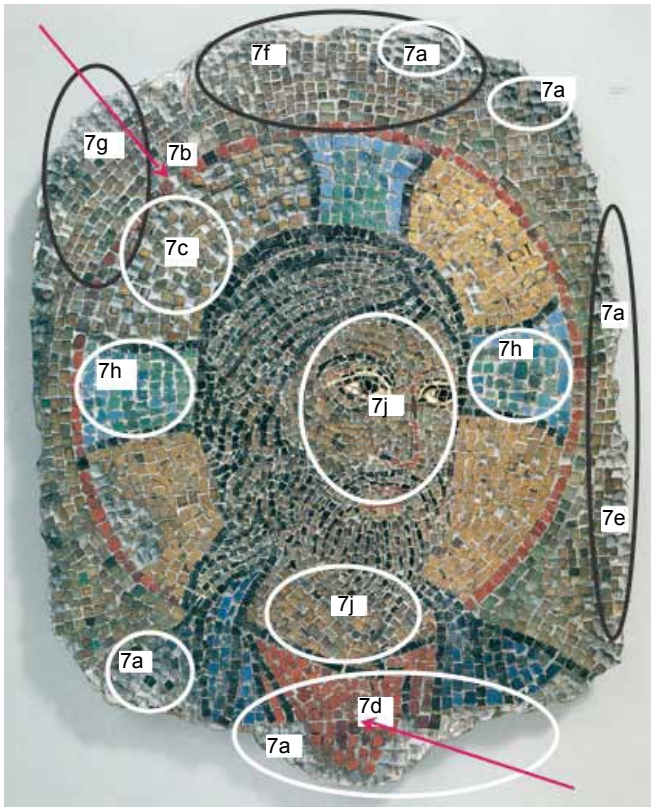


Plate 7a–j Technical analysis of the Jaharis Christ

the panel's bottom in the tunic and mantle area, showing uncharacteristically small, oval-shaped pokes. An original tessera could not have left any tracks in a modern setting bed if the latter was created only after the destruction of the original setting bed.

- no preparatory underpainting visible in any of the empty sockets: there is no red under the one tessera missing from the halo's rim (**Pl. 7b**). The setting bed revealed has the same colour throughout, whether the missing cubes are gold or coloured glass, thus failing to perform the function of an underpainting.
- a suspicious pattern of damage (i.e., of missing tesserae) in the halo's gold ground quadrants. Alone among the quadrants, the one at top left (**Pl. 7c**) has almost half of its tesserae missing (but in a checkerboard pattern), to make it look artificially aged, weathered or battered. Such differences in a mosaic's wear and texture are hard to explain through natural causes. The quadrant that is seemingly more damaged is otherwise rimmed by the same, mostly intact, row of red glass, followed by the outer gold ground around the halo, which is also mostly intact.
- a horizontal cut (only partly executed) across the chest of Christ (**Pl. 7d**), which is intended to be interpreted as the result of an old – and now discarded – restoration practice of lifting the mosaics from the wall in rectangular sections, glued onto cloth or paper. After repair at the bench, the sections were returned to the wall and did not always match, being off by a row or two; they often left behind a noticeable seam in the mosaic's surface. Trying to fill in mentally the sockets of the 'missing' tesserae or to combine the two sections of Christ's shoulders across his chest – which are allegedly separated by the horizontal seam – would yield confusing results: the rows reconstructed in such a way have no internal logic. They are set mostly at random and do not follow each other (not even if we allow for their imperfect fitting back onto the wall, off by one or two rows), despite their being supposed to be part of the same fold in Christ's tunic. As for the mantle, the lower right corner is set in tesserae that go both vertically and horizontally (the latter in the ghost section), while – to judge again from the 'ghost' tracks – the rows on Christ's shoulder at the left were set in no particular pattern.
- the wrong setting of rows in the gold background around Christ's halo, set contrary to Middle Byzantine workshop practices. Along the right side, the rows immediately beyond the halo's contouring rows are mostly indicated by impressions intended to suggest empty sockets (**Pl. 7e**). At the top of the piece, above the halo (**Pl. 7f**), the gold rows are set differently left and right and do not merge or connect with each other, as they should. The section to the left, made with too many concentric rows (**Pl. 7g**), ends against the horizontal rows at the right without the visual transition customary in original mosaics. Another blunder occurs around the halo's contouring rows, which vary in number in the wrong places. Evidently the forger did not study the solutions to background settings used in the original workshops of his alleged time period (compare with **Pls 4a–b, 5** – the top gold area was restored later – and **Pls 6a–b**) because he did not consider the details of execution to be important enough.
- a sloppy and uneven cut of the glass tesserae, especially in the arms of the cross inside the halo (**Pl. 7h**), the coloured tesserae of the garments (**Pl. 7i**) and those of the features proper in the face and neck of Christ (**Pl. 7j**); this kind of cut shows a lack of workshop training. Evenness in cutting tesserae to desired sizes and homogeneous shapes is acquired, like all artisanal skills, through apprenticeship and constant practice. The regularly cut cubes – mostly gold – may possibly have been reused from an ancient mosaic.[10]

Iconographic observations

- Christ's head in the three-quarters position could belong to several narrative scenes, including Palm Sunday (**Pl. 4a–b**), Christ's Temptations by the Devil (**Pl. 5**), the Last Supper, the Washing of the Feet, the Anastasis (**Pl. 8a–c**) and the Doubting of Thomas (**Pl. 39a–b**). The Jaharis mosaicist has chosen a model widely represented in many Middle Byzantine cycles. But the execution is again faulty in the details.
- the fold on the chest (**Pl. 1**), emphasized by the jagged neckline (seen also in all of the originals, in different degrees of achievement shown below for comparison: **Pls 4a–b, 5, 6a–b**), which is not followed in the Jaharis Christ – as it should be – by coloured rows set in patterns to form the fold proper. The red glass cubes, sloppily cut, fill the surface in a disorderly fashion. Maybe we can make allowances for the lack of gold highlights (the chrysographiae or their imitations), which are very common for the period intended, here in examples from the best workshop at Daphni; but even in 'poorer', less

achieved workshops, like the one shown here from San Marco and Kiev's St Sophia, there is never an unmodulated treatment of the garments' fabrics: a number of rows of different and/or related hues must combine to build up to the intended colour (customarily, purple glass and gold/yellow hues, made with glass, terracotta or stone, but also red and, rarely, blue).

- the arms of the cross inscribed in Christ's halo (**Pl. 1**), here coloured with a rather random mixture of green and light blue glass, set in disorder and differently for each arm of the cross. This is another proof of confused thinking. The many representations of Christ with the cross inscribed in his halo follow various types, plain or bejewelled, sometimes both used inside the same monument, depending on the scenes represented (and possibly the mosaicist's preference?). My examples here are from Christological narrative cycles, none of the most common 'bejewelled' type. We look at Daphni (where all crosses in haloes are filled with rows of silver tesserae, horizontal and vertical, respectively, and are framed with one row of red glass tesserae, followed by a row of dark purple glass tesserae, with the ends of the arms slightly expanded, **Pls 4a, 8a**) and at San Marco (where this scene is executed by a lesser workshop: the cross is simplified and indicated by just one straight row of red glass against the gold ground but still the mosaic rows are set in orderly fashion (**Pl. 5**). Another cross type is that with its arms coloured in increasingly dark shades of blue through successive rows arranged vertically on top of Christ's head and horizontally on the sides: the two examples come from St Sophia in Kiev (**Pl. 6a–b**) and date from the early 11th century. Both representations are liturgical, not narrative (one of the medallions is at the center of the Deësis; in the other, Christ appears as Priest).
- the flesh tones, an odd feature, possibly a *hapax*: the face and neck are set with transparent dark amber-coloured glass tesserae (**Pl. 1**). These materials are usually connected with the gold-leaf glass pancakes from which the gold cubes are cut. The rejects from the sides of the pancakes are used in combination with other dark olive or brown hues (or green, when the transparent glass is bottle green) as one of the modulating elements for garments, trees and architecture. In this context, given the importance of the representation, they seem to indicate gold itself, its gold foil missing, though their treatment is not consistent with this reading. Other than the case of St Demetrios' gold hands in one of the Thessaloniki mosaic panels,[11] I do not know of any analogies to this flashy rendering of Christ's flesh, which if genuine would doubtless indicate a theological stance.
- the treatment of the features themselves which is hesitant, incorrect and infelicitous.

Taken all together, the incorrect, modern setting bed, the suspicious patterns of the fabric's destruction, the disregard for the correct rules for setting the gold rows, the sloppy cutting of many of the tesserae and many iconographical errors in the building of the head are irrefutable indicators of a non-medieval mosaicist. Hidden in plain sight, numerous workshop rules for building faces and garments that characterize the proper execution of mosaic decoration escaped this forger to a telling degree: he either did not understand them or, more likely, was unaware of their existence. Such technical incompetence is hard to reconcile with the pretensions exhibited in the choice – full of ideological implications – of the transparent amber/gold tesserae for the complexion of Christ. The lack of attention to detail and sloppiness in execution indicate that if working in a legitimate capacity, this particular artisan would have been only a mediocre archaeologist. To the connoisseur of mosaics, the results of his work are obviously spurious.

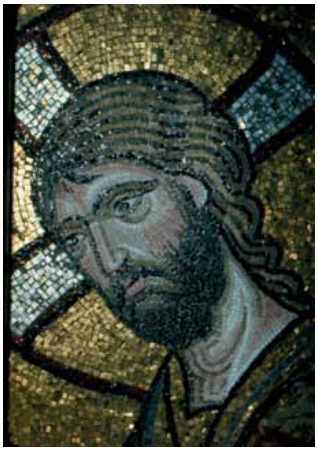
With the knowledge acquired through the *Corpus* survey of the main Middle Byzantine mosaics, the typological analysis of wall mosaics is a fairly straightforward affair, because we are now familiar with the techniques, the materials and the iconographical patterns and their variations that are characteristic of many of the mosaic workshops behind mosaics that have survived to our times. Thanks to the visual possibilities of the computer, we can also expand that analysis and bring up on the same screen simultaneously several elements of the repertoire for detailed close-up comparisons.[12]

Finally, the few following examples of genuine Middle Byzantine mosaics, and a fake one, will give us a context in which to judge the Jaharis Christ.

Starting with the setting bed, here is an example of a medieval wall mosaic detached from the wall but partly restored in modern times, very likely by the Venetian restorer Giovanni Moro. The mosaic represents a head of the Apostle Andrew, now in Milan's Brera Art Gallery, probably removed from Torcello's west wall. The mosaicist, who tampered with the piece so as to conceal its provenance, made it look like a ragged relic, added extra sections to the original core including the letter 'S', and in the process supplemented the original setting bed with additional plaster chunks, which are visible along with the original chunks on the panel's back (**Pl. 2**).[13]

To illustrate the texture of an original mosaic and to contrast it with the fake Jaharis one, there are many possible examples. I have chosen an original, if small, wall mosaic fragment, so far unpublished and undated (but from the Middle Byzantine period), now in the Benaki Museum in Athens (**Pl. 3a–c**).[14] Originally part of a narrative scene at the Monastery of Stoudios in Constantinople, it represents a secondary, male figure in a crowd, identified by his typical head covering made of decorated white fabric, and by what is left of his brow. In cross-section the fragment illustrates the purely technical points of the setting bed: note the two layers of lime plaster and the different depths of setting the tesserae, which vary in size (**Pl. 3b**) so that the resulting surface is smooth and level (**Pl. 3a**). Note as well the reddish ochre preparatory drawing, where a tessera has fallen at the left eyelid. The homogeneous surface of the lime plaster setting bed is visible on the back of the piece (**Pl. 3c**).

The examples chosen next (**Pls 4a–b**, **8a–b**) come from Daphni, a mosaic-decorated church traditionally dated to around 1100 (which is also the proposed date for the Jaharis Christ). The scenes represent partial views of the Entrance into Jerusalem on Palm Sunday (**Pl. 4a–b**) and the Anastasis, the Harrowing of Hell (**Pl. 8a–c**). The



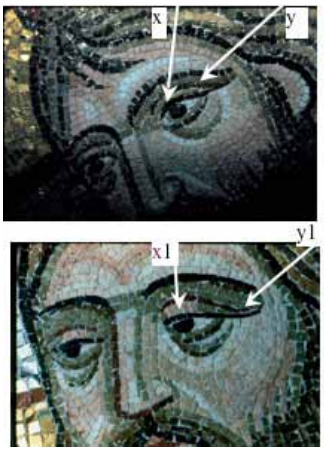


Plate 8a–d: a–c partial view of Christ, Anastasis; d Doubting of Thomas, Daphni monastery

background, here in gold, has the customary orderly setting of the rows, horizontal for the most part, except when they contour various characters' shapes. The exact same description of the background (the formula used here) applies, for example to the Christ from San Marco in the scene of the Third Temptation (**Pl. 5**), with the specification that the mosaicist responsible for this latter figure is much less accomplished than his colleagues working at Daphni (and also that the top of the gold ground was remade later).[15]

Chosen again from Daphni, the close-ups revealing the pattern used for the 'construction' of a head (**Pls 8b, 8c** and **9**) are related in iconography to the Jaharis Christ: the head is turned three-quarters to one side, and inside Christ's halo there is a cross inscribed. We are looking at the Christ in the Anastasis (**Pl. 8b–c**) and the one in the Baptism (Christ's halo with its inscribed cross in the Baptism was remade in the late 19th century, but the head is original, **Pl. 9**). For the Christ head in Daphni's Last Supper – a credible model for the Jaharis fake, especially because of the head's direction – I could not find a colour photograph for this publication.

The formula according to which the Daphni heads were composed is of the highest quality and has been learned from a good model source. Through workshop practice and the personal gifts of the mosaicist, it is also beautifully executed. Still, the elements used in the face and the neck are variants of a vast living repertoire of subjects, recognizable in any Middle Byzantine mosaic, including the less achieved, but still perfectly respectable one in San Marco.

To contrast the originals with both the Jaharis mosaic (**Pl. 10**) and another ghastly fake, I have put on the opposite page the Christ once in the Stoclet collection (**Pl. 11**), whose present whereabouts are unknown to me.[16] This mosaic was once suggested to me in conversation as a potential analogy for the Jaharis head. A side-by-side look at the two mosaics will invalidate the suggestion.[17] In fact, they have almost nothing in common, with the exception of their subject and their spurious and unaesthetic characteristics. Still, the Stoclet Christ is a potentially interesting object to follow, because it was collected by Mr and Mrs Adolphe Stoclet, fabled collectors and patrons in the early 20th century. Though I know little about the assembling of their collection, the details of their approximately six years spent in Milan after the First World War may indicate a possible place where they bought this piece. But wherever the piece was acquired, it would indicate an active forger at work in the early part of the last century.

To enumerate additional blunders, technical, stylistic and iconographic, noticeable in the Jaharis piece, would mostly

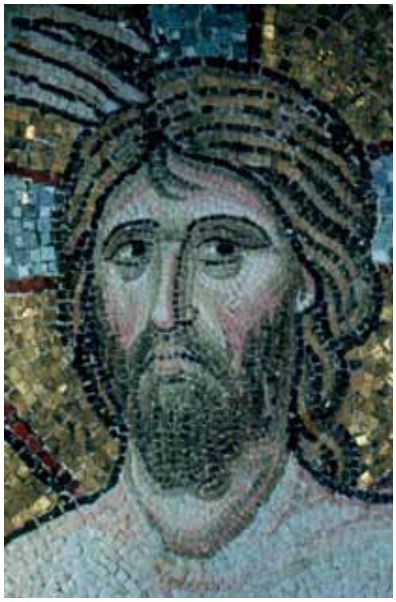


Plate 9 Detail of the Baptism of Christ, Daphni monastery

Plate 10 The Jaharis Christ, Metropolitan Museum of Art, New York

Plate 11 Christ, mosaic formerly in the Stoclet Collection, current location unknown

Plate 12 Mosaic apse, Bode Museum, Berlin

benefit future forgers: they are the category of people most interested in, and able to follow such details. Unlike scholars or curators, who can afford not to be familiar with many of their objects, the forgers' livelihood – or maybe just their income – depends on a critique-proof and marketable product.

The features I have discussed here are – for now at least – almost impossible to fake and therefore recognizable by the trained specialist. But a comment comes to mind that is apposite to the very place of this conference. In *The Burlington Magazine* of 1984, under the Shorter Notices, 'A fake porphyry head' was published by Brian Cook who ends his text thus:

> The precise details of the anachronistic technique that led to the head's condemnation have been deliberately left out of this account, since previous experience suggests that it is undesirable to make such information readily available to forgers… I remain, of course, ready to discuss the question in detail with colleagues who may be concerned with similarly problematical pieces.[18]

This is also my position.[19]

The mosaic apse in the Bode Museum, Berlin (Pl. 12)

The case of the mosaic exhibited in the Museum für Spätantike und Byzantinische Kunst in Berlin is even more egregious. Allegedly the apse of San Michele in Africisco, Ravenna, dating from the mid-6th century, it is in reality a copy made precisely between October 1850 and March 1851 during a well-documented episode of royal Prussian collecting.[20] Here I will not repeat the story of these mosaics, which has been well clarified elsewhere. (The ample literature starts in 1904 with a substantial article by Oskar Wulff, who reviewed the archives in Berlin on this matter,[21] and ends for now with the Acts of the 2006 conference in Ravenna.)[22] But I will offer here a new, unpublished document, 'the smoking gun' of the Berlin affair, which firmly corroborates the mosaic's lack of authenticity.

Despite my two studies, a few scholars have been slow to understand that the entire apse, rather than just parts of it – is a modern copy. Chief among these scholars has been Arne Effenberger, who had written his dissertation on this monument and published two editions of a book on the mosaics (**Pls 13–14**).[23] Effenberger offers no change of his views in the museum guidebook's latest printing in 2008.[24] The problem was made worse by two articles by Claudia Gramentieri,[25] who went to Berlin in the 1990s to study the archives – to which she says she had full access – but inexplicably covered only the documents for the period starting after the Moro episode.[26] She thus missed the preliminary inspections of the mosaic and the contract signed by Moro with the Prussian consulate in Venice in 1850 (copy to Berlin in the archives), as well as the correspondence concerning the repair and transportation of the apse from Venice to Berlin. She also missed the documents connected with the opening much later (in 1875) of the crates sent by Moro, under Max Jordan, the director of the Royal National Gallery, an episode amply summarized by Wulff.[27] In general, Gramentieri missed the fact that she, like almost all her predecessors, was documenting the fate of Giovanni Moro's mid-19th-century replica, and not the original mosaic.

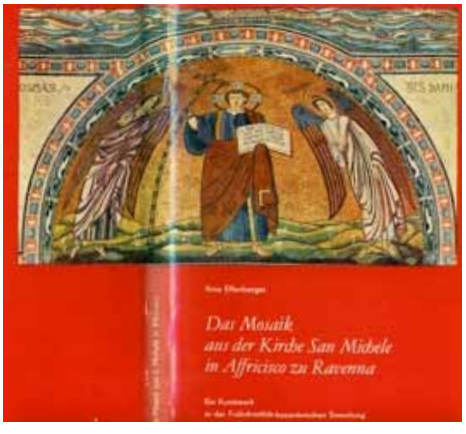


Plate 13 A. Effenberger, *Das Mosaik aus der Kirche San Michele in Affricisco zu Ravenna*, book cover, Berlin, 1975

Plate 14 A. Effenberger, *Das Mosaik aus der Kirche San Michele in Africisco zu Ravenna*, book cover, Berlin, 1989 (2nd edn)

Plate 15 Invitation to the book launch of *San Michele in Africisco e l'età giustinianea a Ravenna*, 4 April 2007

Plate 16 Mosaic head of archangel Michael, before restoration. Museo Provinciale, Torcello

Plate 17 Mosaic head of archangel Michael. Museo Provinciale, Torcello

The cover of the published Acts of the 2006 conference held in Ravenna on San Michele (subtitled 'La diaspora dell' Arcangelo') [28] seems further to confuse the crucial issue: which are the real mosaics of San Michele in Africisco? The volume's title, *San Michele in Africisco e l'età giustinianea a Ravenna*, points to Justinian's period, the mid-6th century, but both the book's cover and the invitation to the book's presentation on 4 April 2007 (**Pl. 15**), are illustrated with Moro's replica of the archangel Michael (patron of the church in Ravenna), masquerading as an original Justinianic mosaic.

From a purely aesthetic point of view, what remains of the original archangel Michael, which was destroyed over time and patched up later (**Pls 16**–**17**), is admittedly not very suitable for top billing on a book cover. However, to choose Moro's copy instead is a gross misrepresentation of the mosaics from Justinian's time, which are particularly well represented in Ravenna. Much closer to the spirit of the original mosaic would have been to use the watercolour made by Enrico Pazzi before Moro's intervention and sent to Berlin in 1843 (**Pls 18–19**).

Among all the Justinianic archangels in Ravenna, the most sophisticated example is the other mosaic head surviving from San Michele, the archangel Gabriel (**Pl. 21**); the copy in Berlin (**Pl. 20**) is another proof of Moro's inferior skills when drawing in free hand. Gabriel's aloof mien and his golden hair with a fringe that is never found elsewhere (well understood and rendered by Pazzi in his watercolour) define with great originality the most refined among the heads surviving from Ravenna's wall mosaics. A close 'competitor' for excellence is the head of the archangel Michael in the apse of San Vitale (**Pl. 22**), along with the archangel Michael from Sant'Apollinare in Classe (**Pl. 23**), here seen in a rubbing made by Alessandro Azzaroni, the famous draftsman and author of numerous plates in Corrado Ricci's opus magnum, *Tavole storiche dei mosaici di Ravenna*.[29] These heads document a wide variety of formulae and solutions, all used for the 'archangel' type within the same limited period, the mid-AD 540s in Ravenna.

It is amazing to me that Moro's work has been considered a 6th-century artefact for so long. Though a poor draftsman, Moro has a style of his own, in fact a range (which depended on the time and care he used for a commission), and it has nothing to do with mosaics made in the 6th century: compare his head of Christ in Berlin (**Pl. 24**) with Christ's head in the apse of San Vitale (**Pl. 25**). Sometimes we can recognize Moro just by the materials he uses even before we come upon any written information attesting his presence at a given site: often the materials he uses in different monuments are the same, regardless of the period of the original mosaics.[30]

Plate 18 Detail of archangel Michael, watercolour, E. Pazzi, *Ravenna, San Michele in Africisco*, 1843, Bode Museum, Berlin

Plate 19 Detail of archangel Gabriel, watercolour, E. Pazzi, *Ravenna, San Michele in Africisco*, 1843, Bode Museum, Berlin

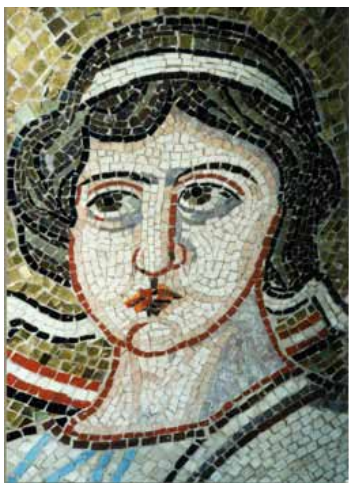


Plate 20 Detail of archangel Gabriel, mosaic, Bode Museum, Berlin

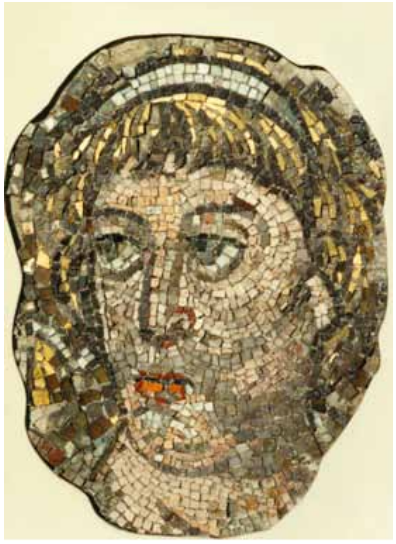


Plate 21 Mosaic head of archangel Gabriel, Museo Provinciale, Torcello

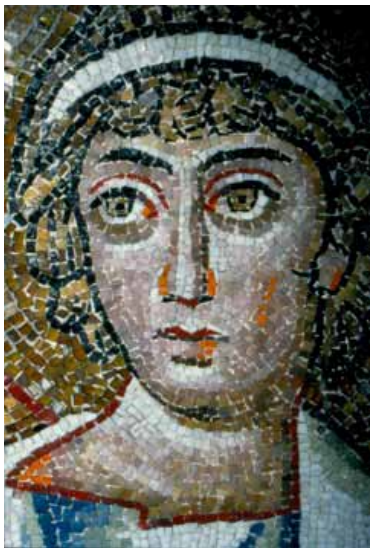


Plate 22 Detail of archangel Michael, main apse, San Vitale, Ravenna

Plate 23 Detail of archangel Michael, Sant'Apollinare in Classe, Ravenna. A. Azzaroni, rubbing of archangel Michael, SA in C, Ra, detail

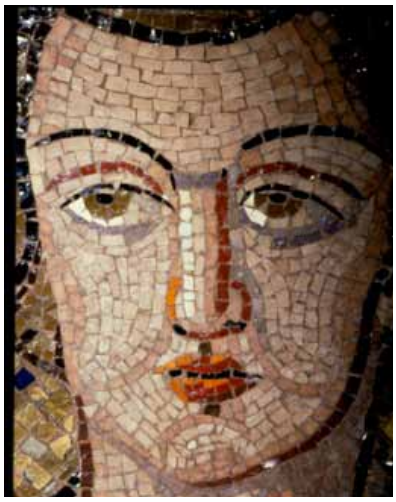


Plate 24 Detail of Christ, mosaic, Bode Museum, Berlin

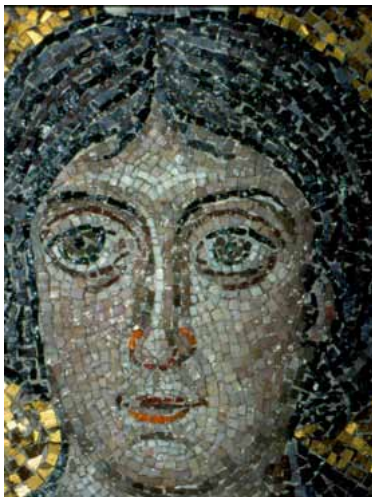


Plate 25 Detail of Christ, mosaic, main apse, San Vitale, Ravenna

For the Prussian commission, Moro was very short of time and did not execute rubbings after the originals but drew the subjects in free hand as underdrawings, on the same paper that served as temporary backing for the tesserae (until the mosaics could be applied permanently on the wall). This solution, which did not force him to cut the tesserae to match the original ones, saved him time and effort. However, the results were very inferior to those obtained by the same Moro when working from real calchi (which he did for Torcello just two years later).[31]

I have already told the story of Moro's authorship of the Berlin mosaic twice, based on my familiarity with Moro's work in Torcello and in Venice and confirmed later by the study of the mosaics in Sant'Ambrogio in Milan. This time I would like to introduce an unpublished document (Appendix B) which further confirms this attribution, if from a completely different angle.

The story is told by Francesco Pajaro, the Venetian dealer for the house of Hohenzollern in the 1840s. It has the advantage of being direct visual testimony instead of scholarly guesswork.

Pajaro had been responsible for the San Michele in Africisco operation from the early 1840s through to 1850, but transferring the mosaics from Ravenna to Berlin had been fraught with delays of many sorts. In the end, short of choices among mosaicists able or willing to get the mosaics ready and packed for the journey to Berlin, Pajaro found the Venetian Giovanni Moro. Moro promised to work on the Ravenna mosaics as soon as he was finished with his commission in progress at Sant'Ambrogio in Milan in 1847. Then there was the delay caused by the turmoil of 1848. Finally, Moro signed a contract with the Prussian consul in Venice on 30 September 1850 which included the time frame for executing the commission (six months), the total amount paid to the mosaicist (5,000 Austrian pounds), the penalty for delays in the delivery (500 Austrian pounds), and the specification that

> nel suespresso prezzo di Lire Cinque mille Austriache, si intendono compresi a carico del Mosaicista Sig.r Moro, tutti gli smalti, paste, cemento ed essenzialmente tutto l'oro di cui è formato tanto il catino quanto gli altri pezzi, come viene dimostrato dal disegno, insomma s'intende compresa ogni spesa di materiale e mano d'opera per ridurre il lavoro ad intiera perfezione.[32]

Thus the contract stipulated that all materials, glass paste, cement and gold (tesserae) for the apse and the other areas, as well as the labour, were included in this amount. We should keep in mind this clause – which was standard

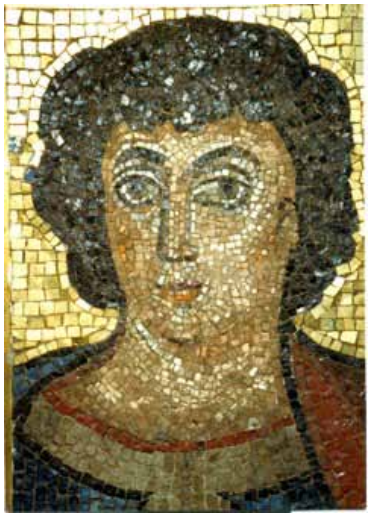


Plate 26 Detail of Christ, mosaic, Bode Museum, Berlin

Plate 27 Mosaic head of Christ, Victoria and Albert Museum, London

practice at the time, as is shown by other preserved contracts – when discussing the identity of materials (ancient or new) used for restoring mosaics.[33] Additional testimony relating to the customary use of gold tesserae can be read in Appendix A.

Once Moro had his contract in 1850, his association with Pajaro became distant, and the latter disappeared from the later dealings between Moro and the Prussian establishment. Several years later, in 1858, under circumstances too long to summarize here, Moro became the object of a major judicial procedure in Venice.[34] A search of his house yielded many detached original wall mosaics and Moro, imprisoned, was interrogated about their provenance. One of these heads, identified as coming from San Michele in Africisco – unfortunately without further details in the police report – was declared by Moro to belong to Pajaro and to have been left with Moro since the days of the Prussian commission.

Thus, in the preliminary inquiry, Pajaro was called to testify in front of the judge in Venice. It is his testimony that I publish here as Appendix B. On this occasion, even though not directly asked by the judge, Pajaro tells the story of how, several years earlier, he had visited Moro in his workshop and noticed that the entire mosaic had been made anew and that it was almost finished. He adds that the original parts – some still attached to the paper with which they had been detached in Ravenna by Pajaro himself (in fact by the late Salandri, my note) – were piled aside in a corner:

> Potei però una volta introdurmi nella casa del Moro, e colà ebbi a rimarcare che costui ad un mosaico dell' Epoca della dominazione Gota in Italia *avea sostituito un lavoro moderno senza valersi del materiale antico* [italics mine] . Perchè poi abbia egli fatto ciò io non potrei dirlo se per mira di lucro o per ignoranza artistica. Osservo però che io ebbi a recarmi a casa del Moro una volta quando il Mosaico era già compiuto quasi per intero, ed ebbi a rimarcare parte del materiale antico, accumulato in un angolo del laboratorio e parte disposto ancora illeso pelle tele come io lo avea levato. Però è possibile che il Moro non l' abbia questa parte usata come avrebbe potuto per aver già prima commesso il grave errore di adoperare nella ricostruzione quadrelli d' una grandezza maggior degli antichi onde le figure ebbero ad accrescere di estensione, e con ciò risultava impossibile l'applicare nessuna delle parti antiche che avrebbe resa evidente fin troppo la sproporzione e di disegno e di lavoro. Ma ripeto precisamente io non posso dire se nel procedere del Moro in quel lavoro egli operasse così per avidità di lucro o per ignoranza artistica. Ed è appunto per ciò anzi che io ebbi a rappresentare tale condizione al Cav. Treves con mio rapporto affinchè provvedesse, e rimasto questo inefficace ne presentai un secondo colla copia del primo al Console Becker perchè rimanesse questa mia protesta contro il lavoro di quel mosaico. Siccome però tutto ciò no ebbe alcun frutto, così convien dire che Treves siassi accontentato del modo in cui ebbe a procedere il Moro [extract from Appendix B].

As for Moro's reason for ignoring the ancient mosaic ('dell'Epoca della dominazione Gota in Italia') and substituting a modern work without using the ancient materials ('un lavoro moderno senza valersi del materiale antico'), Pajaro cannot decide whether it was because of artistic ignorance or of cupidity. He speculates that the substitution might have happened because Moro mistakenly used rectangles sized larger than the original sheets that had been lifted from the wall, and then, with the proportions hopelessly skewed, was no longer able to apply any of the original sections to the overall wooden form.[35] In 1858, when summoned as a witness, Pajaro goes on to inform the judge that at the time (most likely before March 1851, because he refers to the new mosaic as being already finished), he had reported this 'discovery' to no avail, both to Treves (the Prussian consul in Venice at the time, J[akob?] Treves) and again to a certain Becker, Prussian consul in Venice, probably Treves' successor.[36]

Pajaro's story explains the discovery that puzzled Max Jordan, who upon opening Moro's crates in 1875 noticed that the paper sections to which the tesserae were attached had been painted in the manner of an underdrawing, rather than having been used to lift the original mosaic fabric face down from its original setting bed.[37]

The results of my detailed survey of the Berlin apse match well with Pajaro's story: several kinds of tesserae are used in the mosaic, but they are all new throughout, the glass itself and the size and shapes of the tesserae, as these pictures show (**Pls 20, 24**). What is more, the newer, restored parts of the Christ now at the Victoria & Albert Museum, especially the blue and red glass in the garments, match perfectly the design and materials used for the central Christ in Berlin (**Pls 26–7**).[38]

Plate 28a–b Arrangement for the 'Glory of Byzantium' exhibition, Metropolitan Museum of Art, New York, 1997; a: mosaic head of an angel from Santa Maria Assunta, Torcello, west wall (hereafter abbreviated to TO, SMA, W), III, a11, Musée du Louvre, Paris [TO, SMA, W III, a11]; b: Talygarn/Lauder mosaic head of an apostle [TO, SMA, W III], private collection

On his death in 1874,[39] Moro left behind the two archangel heads (**Pls 16, 17, 21**), which later, in 1891, were bought by Cesare Augusto Levi for the Museo Provinciale di Torcello from a wine merchant who had contracted to pay Moro a life annuity and also purchased some of his belongings from his heirs.[40] The head of Christ from the San Michele apse (**Pl. 27**) had been bought long before, in 1856, by John Charles Robinson for the collections of the future Victoria and Albert Museum.[41] It survives in its spruced-up Moro version, and it should be well known to all of us, especially after the exhibition on Byzantium at the Royal Academy.[42] Despite Moro's removal of several identifying attributes from the Victoria and Albert Museum Christ, such as the original halo and cross, which have been replaced by modern gold glass tesserae, and also his modification of the original Christ's garments, now red and blue rather than the original and customary purple, the generic resemblance of the mosaics remains undeniable.

Moro was just one of the most prolific restorers/fakers of his time – the 1840s and 50s. Though he was once practically unknown, my rediscovery of him in the early 1970s[43] has now revealed his involvement with some of the most important mosaic-decorated monuments in northern Italy. I have already pointed out here some of his sloppiest works, including the apse of San Michele in Africisco in its entirety, but there are several more mosaics extensively remade by Moro.

Still, he was not the only modern destroyer of ancient mosaics. His younger contemporary Antonio Salviati[44] had a large part in the continuing destruction of mosaics in San Marco[45] and Torcello, where the first three registers of the west wall were massively remade by his team in the 1871–2 campaign.[46] Twenty years after the Moro episode, a final havoc was wreaked upon the most 'inhabited' register of the Last Judgment, the third, which displayed 19 main figures – the central Deesis group and 12 apostles – and 28 angels behind them, ready to be mined for their heads. During the massacre carried out over these few years, the order of the heads of the apostles was changed forever on the wall, so that later many a scholar has been put to shame in the process of explaining some very unorthodox iconography for the 12 apostles at Torcello. The second and the third registers are presented here in two partial views, a photograph of the area and the analytic chart published in 1976, respectively (**Pls 43, 44**).[47]

Because of the *Corpus*,[48] a remarkable number of detached mosaic heads have been discovered and identified in the last 25 years (some of them as fakes, others as partly original and altered to various degrees, but a few in an excellent state). Most of the removed and copied heads can be traced to the activities of Moro or those of the Salviati team, 20 years later.

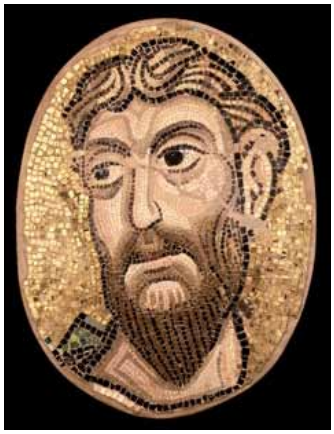
One of these heads, considerably altered, was the original Christ from San Michele in Africisco (**Pl. 26**), just discussed. Another head (**Pls 28b, 32**), only partly altered (**Pl. 33**), is among the most important finds of this crop. Originally located in the third register of the west wall at Torcello, it represents one of the original 12 apostles. Its copy is now in position A12 on the wall (**Pl. 34**), not the mosaic's original position. The original head, which surfaced in 1986 at Talygarn in Wales, was bought at auction[49] by another collector (Ronald Lauder) and for several years was on display at the Metropolitan Museum of Art, next to the Jaharis Christ.[50]

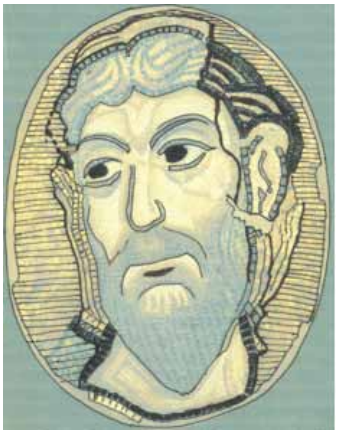
The Talygarn head had been exhibited in 1997 at the 'Glory of Byzantium' exhibition (**Pls 28b, 32**)[51] alongside an extraordinary angel head known as the Cluny or Louvre head (**Pls 28a, 29**), which originally came from the same register III of the west wall at Torcello. Both heads had left Venice surreptitiously, possibly at about the same time, in the 1870s, but the angel went to France with the mosaicist E. Gerspach (along with a half-head of another angel which was donated in 1877 also by Gerspach, **Pl. 30**)[52] and ended up at the Louvre, while the apostle head (**Pls 28b, 32**) went to Wales with George Clark. Another original angel head

Plate 29 Mosaic head, angel, Musée du Louvre, Paris (TO, SMA, W III, a11)

Plate 30 Mosaic head of an angel, Musée National de la Céramique, Sèvres (TO, SMA, W III, a12)

Plate 31 Mosaic head of an angel, Museo Provinciale, Torcello (TO, SMA, W III, a13)





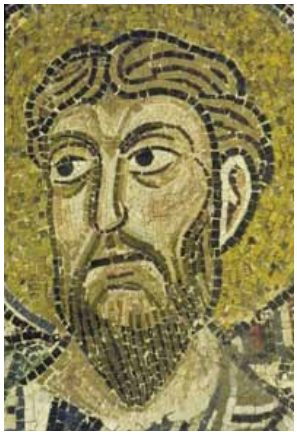


Plate 32 Talygarn/Lauder mosaic head of an apostle

Plate 33 Talygarn/Lauder mosaic head of an apostle, chronological chart

Plate 34 Mosaic head of an apostle, west wall, Santa Maria Assunta, Torcello (TO, SMA, W III, A12)

from the same register on the west wall at Torcello (**Pl. 31**) was donated much later, in 1930, to the Provincia di Venezia by the Venetian mosaicist Augusto Agazzi, who had stolen it in his youth (in the 1870s) from the west wall. This head has been exhibited for many years in Torcello's Museo Provinciale though it was not attributed to any position on the west wall until 1997.[53]

At the time of the exhibition at the Metropolitan Museum, I suggested to the organisers that they bring over the angel head from Torcello's Museo Provinciale as well, and show it next to the other two mosaics (**Pl. 28a**–**b**), all from the same register of the Last Judgment, but my suggestion fell on deaf ears. It would have been an excellent opportunity for scholars who had not benefited from the scaffoldings at Torcello to compare and contrast different 'hands' working side by side within the original workshop.[54]

The mosaicists discussed here – some of them identified by name – did not set out to be fakers. In fact, their contracts were to restore and preserve the mosaics on the wall. Various circumstances however, including Salviati's theories that called for total renewal of the old mosaics,[55] made them overstep the boundaries of their agreements, and it seems that some collectors were also pleased to receive the mosaic heads as gifts or for very little money. As far as I can tell, the mosaic heads never commanded large prices, but were good-will gifts, made perhaps in the hope of future commissions or at the end of a satisfying transaction (maybe in Clark's case).[56] However, some travellers to Venice and amateur collectors got copies. This happened to Arthur Evans, whose mosaic head of an angel (**Pl. 35**) is now at the Rochester Memorial Art Gallery in Rochester, New York, a mirror copy of angel W, III, a20 at Torcello (**Pl. 36**). It happened also to a British collector whose heirs own a spurious mosaic head of an old man (**Pl. 37**), inspired to a certain extent by the head of the Apostle Matthew in the main portal of San Marco (**Pl. 38**), but executed with modern materials.[57]

Sometimes, copies made of certain mosaics were openly produced, in order to fill gaps within a lacunose decoration still on the wall with close approximations of the originals. The mosaics of Daphni come once again to mind, this time in connection with the missing heads of Christ which needed redoing. One example here sets side by side a close-up of Christ's head from the scene of the Doubting of Thomas, entirely remade in the 1890s (**Pls 8d, 39a–b**), and a close-up of Christ's head from the original Anastasis (**Pls 8a–c, 39c**) along with Christ's original head from the Baptism for an overall comparison and contrast (**Pl.9**). We notice both the bona fide effort of the Daphni restorer to come as close as he can to the original model, probably by means of a calco, but also his inability to do so successfully, because – unlike the original artisan – he was no longer fluent in this 'idiom' and he – like the Jaharis faker – did not understand all the rules 'hidden in plain sight'. Notice, just as an example, the difference between the two heads in the building of the eye sockets; the modern version follows the original pattern but twice uses two rows (**Pl. 39b,** arrows **x1** and **y1**), rather than the single row (**Pl. 39c,** arrows **x** and **y**) used in the original.[58]

Copying the heads at Torcello in 1853 (**Pl. 42**),[59] Moro performed noticeably better than he had for the San Michele mosaics, possibly because he took more time for their

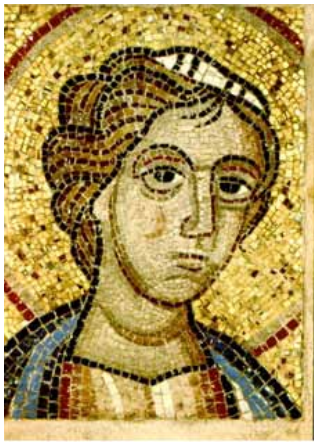
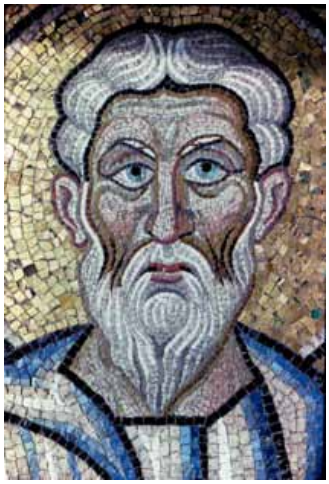


Plate 35 Mosaic head of an angel, Memorial Art Gallery, Rochester (mirror copy of TO, SMA, W III,a20)

Plate 36 Mosaic head of an angel, west wall, Santa Maria Assunta, Torcello (W III,a20)



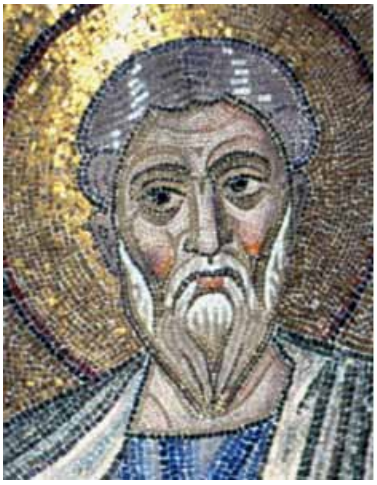


Plate 37 Mosaic head of an old man, 19th century, private collection, UK

Plate 38 Mosaic head of Apostle Matthew, atrium, San Marco, Venice

execution and also because he used the 'Cartoni piccoli a colori, ed i Cartoni grandi a semplici contorni'[60] detailed in his contract. Still, there are some noticeable iconographical slips in his copies, because Moro did not really know Byzantine mosaic grammar or iconography. Here is the (very slightly restored, most likely by Moro himself) original head of the prophet David in the Anastasis, in the west wall's II register (**Pls 40a, 41, 43**) and two details from Moro's copy (**Pl. 40b–c**). The original also had *praependulia* (only one *praependulium*, in fact, given the three-quarter pose of the head) as part of the regal crown, starting at the crown's side and hanging over the king's hair at [our] right: this is one of several types of royal crowns used in the 11th century.[61] Moro ignored the strings of pearls altogether (**Pl. 40b–c**), and finished the side of the crown in his copy with a checkerboard row (**Pl. 40b**) of alternating black and white square-shaped tesserae (which in the original were round 'pearls' (**Pls 40a, 41, 43**).

As for reusing materials, for the white streaks in David's beard (and for replacing some missing round pearls in the original head), Moro introduces white glass paste, a material not found in the original 11th-century Torcello workshop. It may be that Moro reused a number of white glass tesserae – a common material in mid-6th-century Ravenna – which he had recovered from the San Michele in Africisco mosaics.

Over the years, and with the help of the detached heads, I have gradually reconstructed sections of the original order of the III register at Torcello, and now I can even identify certain divisions of labour among 'hands' in what is left of the original, 11th-century workshop. Most of this information can be found directly in the mosaics themselves. I have only become able to distinguish later interventions in the original texture, and even spurious compositions on detached panels, after many years spent on various scaffoldings at mosaic-decorated monuments, actively and routinely surveying and filling out forms, measuring and photographing wall mosaics according to the Corpus format, and in the process understanding the inner workings and rules controlling the original workshops. The other illuminating information for all matters connected with these long-lived monuments – which clarifies our data and reduces our speculation about how certain workshops organized their trade – can be found in the archives, when they are preserved. Some archives are classics, such as the ones connected with the organization of the building site of the Orvieto cathedral in the 14th century and the lists of supplies for the mosaics projected (unfortunately the original mosaics do not survive, since they had been replaced by the end of the 19th century). Other archives are still large, unexploited resources that will require much tedious sifting and processing in order to yield results, a process very similar to conducting the surveys of the real mosaics from scaffoldings (as opposed to just from photographs).

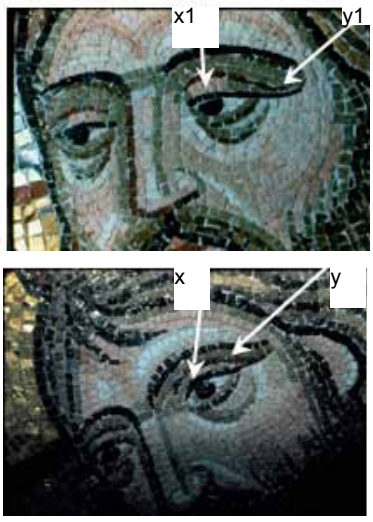


Plate 39a–c: a–b detail of Christ from the Incredulity of Thomas; c detail from the Anastasis, Daphni monastery

Plate 40 a–c a (far left): detail of King David, Santa Maria Assunta, Torcello (TO, SMA,W II, 3); b (left, top): detail of sacristy mosaic, Santa Maria Assunta, Torcello, copy by Moro; c (left, bottom): detail of sacristy mosaic, Santa Maria Assunta, Torcello, copy by Moro

From Moro's Venetian and Milanese contracts for restoring mosaics we know that the materials, especially the glass tesserae, were recycled habitually from cannibalized older mosaics (sorted out explicitly even by colours), and that gold tesserae were especially valuable, among other reasons because of the technical difficulties in achieving a stable gold leaf under a thin sheet of transparent glass. This indisputable information should make us very circumspect about attempts to establish 'objective' methods when identifying mosaics based on their materials, if taken separately and divorced from 'subjective' judgment based on connoisseurship.

Unfortunately, connoisseurship is at a low ebb nowadays, especially in United States art history graduate programmes in recent decades.[62] At the 21st Byzantine Congress in 2006[63] the panel dedicated to 'Fakes' expressed some discouragement. Anthony Cutler, the co-ordinator, spoke on 'Fakes in Practice and in Theory':

> [T]heir norms [that of the faker and of his scientific or scholarly nemesis] are things of their own creation and thus contingent on what they know (and don't know) about the field in question. And what of exceptions to the supposed 'rules'? In the imperfect state of our knowledge, is it not possible that it is our rules and not the object in question [that] are being tested?[64]

At least for wall mosaics, after the *Corpus* our information today is on more solid ground and allows for much clearer answers then in the old days of 'photography only.' Photography has been of course an invaluable tool, but nothing can replace the direct survey, which offers statistical evidence as well. After all, workshop training and rules did exist and were the norm when mosaic making was a living art.[65]

In the same panel about fakes, Gary Vikan expressed more urgency:

> [F]or museum curators and directors this game of authentication is at once more pressing and serious…. [T]he mandate which compels us all toward issues of authenticity is… to make as certain as possible that we present the public only those works of art that speak truthfully for the past. To do less, is to join, at least passively, the forger's trade in deception.[66]

The Metropolitan Museum of Art and the Bode Museum have set a bad example by identifying pieces in their galleries as something other than what they are. There would be nothing wrong with exhibiting the mosaic apse in Berlin clearly labeled as a copy made by Giovanni Moro in 1850–1 after the 6th-century mosaic in Ravenna. This would be, after all, an exhibit representative of a certain period in the history of collecting and restoring mosaics, in good or bad faith, competently or otherwise.

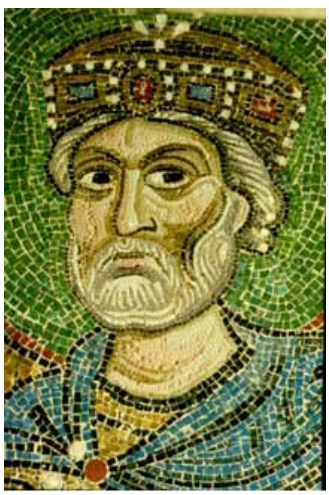


Plate 41, Detail of King David, Santa Maria Assunta, Torcello (TO, SMA,W II, 3)

Plate 42 Mosaic frame copies by G. Moro in the sacristy of Santa Maria Assunta, Torcello

Plate 43 West wall, registers II and III, Santa Maria Assunta, Torcello

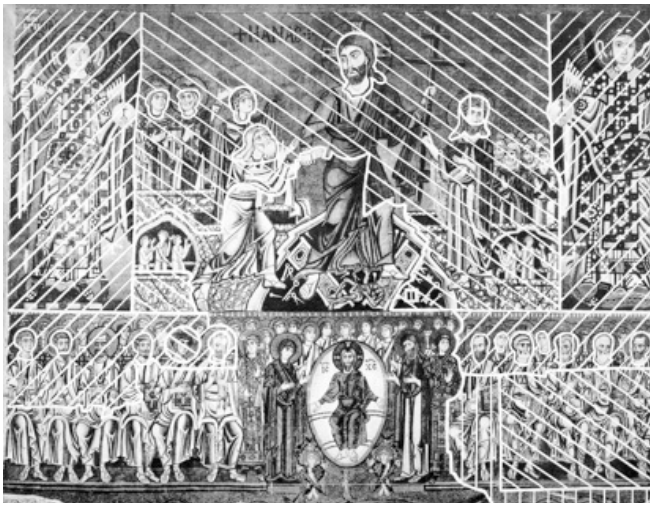


Plate 44 West wall, registers II and III, chronological chart, Santa Maria Assunta, Torcello

As for the Jaharis Christ, made by an unknown modern and probably contemporary mosaicist, it is misleading to have had it exhibited next to the Talygarn Apostle head, a mostly medieval mosaic despite its modern patches, or to have it exhibited as a genuine medieval artefact – unless of course it is exhibited for didactic reasons, in order to contrast the real and the fake.[67]

Appendix A: On the supply of gold tesserae at the Church of San Marco, Venice and the disposal under the contract of materials resulting from the destruction of mosaics

Archivio di Stato Venezia, Presidenza Luogotenenza lombardo – veneta, B. 390
Processo Moro, 'Giornale del processo pendente presso l'I. R. Cons. nob. Barbaro contro Giovanni Moro arrestato'.

item no. 12: Examination of G.B. Meduna, 12 April 1858 [Tribunale Provinciale, Sezione Penale]; excerpt, previously unpublished.

12
2 Quanto alla demolizione del Mosaico che era sulla volta presso all' altare della Madonna nella stessa basilica di S. Marco, io gli ordinai di levarlo e di conservare il tutto nel deposito della Basilica non di portare a casa e di pulire il vetro dorato che formava parte di quel mosaico; di questo vetro poi ne impiego parte nel rifare il mosaico del catino vicino alla volta dell' Apocalisse, non essendogli bastato quello che di cui avea levato e che avea avuto l' incarico di polire verso la mercedde di c.mi 25 la libbra. Se poi il Moro avea bisogno di mosaico dorato, egli è certo che veniva con ciò a escludere di averne a casa, e se ne ha nella sua abitazione, ei veniva con ciò a comettere un' inganno verso di me, col dirmi che non ne avea di servibile. Io però mi sono fidato sempre tanto più che già a lavoro finito si sarebbe da me fatto il riscontro tra la quantità consegnatali e quella levata dal sito stesso del lavoro con quella messa in opera, e se ci fosse stata una differenza, cioè se la quantità impiegata fosse stata inferiore alla quantità da esso avuta egli avrebbe dovuto rispondere o col offrire la differenza in altrettanti frammenti inservibili, o col render conto del dove fossessi consumato da lui. Da un calcolo semplicemente approssimativo, che feci in seguito all' esser stato sentito su questo affare dall' I. R. Direzione di Polizia, tra il vetro dorato che il Moro ricevette e quello che impiegò, ci sarebbe la differenza in più avuto di circa 400 lib. che se non sono frammenti inservibili, convien dire che il Moro abbia commesso un inganno quando me ne chiedeva di buono perché con ciò veniva ad escludere di averne di servibile

3 Fattogli presente il differente tenore del deposto di Giovanni Moro ed interr.o opportunamente

R: Io non ho che a riportarmi a quanto dissi, e ripeto che pel vetro dorato egli avea incarico di portarsi acasa e di pulire quello solo del catino, e che se me ne chiese dell'altro veniva, come già dissi ad escludere di averne di buono in casa di quello catino stesso.

item no. 15: Moro's Contract with the Provincial Delegate of the Provisional Government 14 October 1848 nr. 4664/700 for the restoration of the wall mosaics in Santa Maria Assunta, Torcello; excerpt, mostly unpublished.

15
al N.m 4664/700
Venezia lì 14 Ottobre 1848

Col Decreto 18 febbraro 1848 N.o 5787 essendo stata autorizzata la stipulazione del Contratto col Mosaicista Giovanni Moro per ristauro del Mosaico esistente nella Chiesa ex Cattedrale di Torcello per pattuito prezzo di lire a[ustriache] 3641:= /tremilla seicento quarantuna/ il sottoscritto Delegato Provinciale faciente pel Governo Provisorio di Venezia ed il sullodato Appaltatore Giovanni Moro sono venuti alla stipulazione del Seguente Contratto colle sotto descritte condizioni:
[……]
4.o Sarà poi rilasciato gratuitamente il materiale risultante della demolizione delle parti del Mosaico vecchio de rinnovare, ed egli d' altronde dichiara che non sarà mai per pretendere alcun indennizzi per le spese di trasporto e di viaggi che dovesse incontrare da questa Città in Torcello.

R. Uff.o d.l Ing.e in Capo Venezia 10 Ottobre 1841
Capitolato deferittivo e Normale pell' eseguimento del Lavoro di riordino parziale del quadro a Mosaico sopra la Porta Maggiore dell'interno del Tempio ex= Cattedrale di Torcello.
I Articoli deferittivi
[…]
4.o Nella detta superficie saranno levati gli smalti, e separati, dopo aver eseguiti i Cartoni piccoli a colouri, ed i Cartoni grandi a semplici contorni.
Sarà poi scrostato il muro, bene nettate le Commissure delle pietre e poste le scalette d' intonaco a calce e terrazzo sulla muratura bene adequata.
Per ultimo si stenderà il cemento di calce di cogolo e polvere di Rovigno i parti eguali, nel quale saranno posti li smalti.5.o Nel caso che levati li detti smalti si riconoscesse abbisognevole il muro di una repedonatura in qualche parte, sarà eseguita coi soliti metodi d' arte, e compensata coi prezzi in corso dietro rilievi di fatto.
7.o Sicome di due generi risultano i lavori di Mosaico nel quadro sopra la porta della Chiesa, cioè figurato Greco con fondo d' oro e figurato semplice e di due generi pure quelli del Mosaico dietro l' Altar Maggiore ossia fondo d' oro e figurato greco semplice, così si stabiliscono i prezzi per ciascheduno dei detti lavori, usitati ed approvati per i lavori finiti in questa Basilica di S. Marco, cioè di Austriache Lire quaranta /:40:/ pel fondo d' oro, Lire trentasei /:36:/ pel figurato Greco con fondo d' oro, e Lire trenta /:30:/ pel figurato greco semplice, i quali prezzi riferiti alla superficie di ciascun piede veneto quadrato di lavoro serviranno di base alla finale liqidazione di tutta l' opera in seguito all' esposto dell' articolo terzo antecedente.
II Articoli normali
8 L'opera dovrà riuscire solida e perfettamente eseguita, sotto la sorveglianza d' un capace conoscitore, il quale verrà destinato dalla I. R. Delegazione Prov.le in concorso dell' I. R. Accedemia di Belle Arti alla quale in ispecialità spetterà la direzione del lavoro.
9 La somma addebitata verrà corrisposta in quattro eguali rate, tre i corso di lavoro, ed una a Collaudo approvato il quale Collaudo sarà impartito dal' I. R. Accademia di Belle Arti per mezzo degli Uffici degl' I. R. Professori di pittura e di Ornamento

item no. 16:Examination of G.B. Meduna, 3 April 1858 [Direzione di Polizia, Venezia]; excerpt, previously unpublished.

16
Int. Se conosce un Giovanni Moro
R. S' Ella mi parla del mosaicista della Chiesa di S. Marco Gio. Moro, lo conosco avendo anzi spesso a fare con lui, pei lavori che si eseguirono nella Basilica di S. Marco

Int. L' E. E. non avesse mai motivo di sospettare della esatezza di detto Mosaicista
R mai; ben le dirò, che oltre due mesi or sono, il nob. Gio. Batt. Contarini I.R. Ciambellano di S. Maestà, e presidente della fabbriceria di S.Marco, dichiarava di aver per udito da un Canonico di quella Chiesa, di cui dicevan anche il nome che ora non ricordo, che il Moro avesse impiegato nei Mosaici della Chiesa di Torcello del cui restauro egli ha l'impresa, degli smalti in oro della Basilica di S. Marco. Di ciò io informato nella circostanza, che il Moro ebbe a chiedermi degli smalti in oro pel completamento del restauro del catino presso alla volta dell' Apocalisse nella detta Basilica, del cui ristauro occupavasi, parendomi che non dovesse averne il bisogno, trovai opportuno accenargli le voci che correvano a suo carico, voci … ch' egli respingeva con qualche risentimento, dichiarandomi, che la calunnia era da ciò dimostrata, che gli smalti d' oro della Basilica di S. Marco erano ben diversi da quelli impiegati nel restauro dei mosaici della Chiesa di Torcello, inquantoché quelli impiegati nella Chiesa di Torcello erano di minori dimmensioni. Ad ogni modo io pensando che nella liquidazione finale avrei potuto riconoscere se venisse o no da lui interamente impiegato il materiale da me fornitogli per mosaici di S.Marco, mi prestai alla sua domanda somministrandogli ora non ben ricordo se cinquanta o cento libbre [Italics mine] di smalto d'oro.

Int. Chi fornisce gli smalti d' oro agli usi della Chiesa di S. Marco
R. La fabbriceria tiene un deposito di molti smalti d' oro dipendente dalle demolizioni che ebbero luogo a più riprese nella detta Chiesa, e quel deposito appunto fornisce il materiale pei lavori commessi al Moro, e soltanto due anni addietro, occorendo degli smalti d' oro d' una tinta particolare, che non trovavansi nel deposito, si dovette comperarlo da certo Radi di Murano nel peso di oltre seicento libbre sottili.

Appendix B: Pajaro's statement on Moro's new version of the San Michele in Africisco apse mosaics

Archivio di Stato Venezia, Presidenza Luogotenenza lombardo – veneta, B. 390 [Processo Moro, 'Giornale del processo pendente presso l'I. R. Cons. nob. Barbaro contro Giovanni Moro arrestato'.

item no. 49: Examination of Francesco Pajaro, 31 May 1858 [Tribunale Provinciale, Sezione Penale]; previously unpublished.

Nell' I. R. Tribunale. Provinciale. Sez.e Penale, Venezia Li 31 Maggio 1858, ore 2 p m
Presenti: L' I. R. Cons. Nob. Barbaro
Ferruzzi prat.
Citato comparve il signor Pajaro antiquario, che ammonito al vero a termini di legge, fù:

1 Int.o Sulle generali
R. Sono Francesco Pajaro di Angelo, d' anni 53, nato a Venezia, e quivi domiciliato, quasi ordinariamente però dimoro al taglio della Mira comune di Gambarare, ammogliato senza figli, cattolico, antiquario e possidente, incensurato, so leggere e scrivere, non immagino il motivo del esame

2 Int.o sulle speciali

R. Nel 1842 dietro incarico avuto da S. M. Il Re di Prussia mi recai a Ravenna per distaccare il mosaico che esisteva nella capella Maggiore del locale altra volta S. Michele a Ravenna, mosaico che S. M. avea comperato, e che io doveva trasportare a Venezia per ristaurarlo, lochè infatti fu fatto allora per opera del mosaicista or defunto Liborio Salandri meno qualche piccola porzione di campo dorato. Sopravenne la Rivoluzione del 1848 prima che io potessi spedire il mosaico a Berlino, ed allora io dovetti partire di Venezia, restandone assente per tutto il tempo degli sconvolgimenti. Al mio ritorno io mi recai dove abitava nel Palazzo Sanudo ai Tolentini, dove esisteva appunto in una sala il Mosaico, e colà ebbi a vederlo guasto gravemente da due colpi di canone, e di più altri guasti nonlievi recati dal dente dei topi. Allora io dovetti esporre la cosa al Treves quale console Prussiano ed egli venuto ed assicuratossi de guasti davami incarico di far rapporto pel modo in cui restaurarlo, ed io il faceva propponendo il mosaicista Moro. Accoltosi il mio progetto, io veniva escluso tacitamente dalla sorveglianza di quel lavoro, che l' aveva oltre il Cav.e Treves anche un pittore prussiano Sig.r Nerli che credo abiti ancora a Venezia, ed un ingegnere che credo accudisca agli affari Treves. Potei però una volta introdurmi nella casa el Moro, e colà ebbi a rimarcare che costui ad un mosaico dell' Epoca della dominazione Gota in Italia avea sostituito un lavoro moderno senza valersi del materiale antico. Perchè poi abbia egli fatto ciò io non potrei dirlo se per mira di lucro o per ignoranza artistica. Osservo però che io ebbi a recarmi a casa del Moro una volta quando il Mosaico era già compiuto quasi per intero, ed ebbi a rimarcare parte del materiale antico, accumulato in un angolo del laboratorio e parte ancora illeso pelle tele come io lo avea levato. Però è possibile che il Moro non l' abbia questa parte usata come avrebbe potuto per aver già prima commesso il grave errore di adoperare nella ricostruzione quadrelli d' una grandezza maggior degli antichi onde le figure ebbero adaccrescere di estensione, e con ciò risultava impossibile l' applicare nessuna delle parti antiche che avrebbe resa evidente fin troppo la sproporzione e di disegno e di lavoro. Ma ripeto precisamente io non posso dire se nel procedere del Moro in quel lavoro egli operasse così per avidità di lucro o per ignoranza artistica. Ed è appunto per ciò anzi che io ebbi a rappresentare tale condizione al Cav. Treves con mio rapporto affinchè provvedesse, e rimasto questo inefficace ne presentai un secondo colla copia del primo al Console Becker perchè rimanesse questa mia .... protesta contro il lavoro di quel mosaico. Siccome però tutto ciò no ebbe alcun frutto, così convien dire che Treves siassi accontentato del modo in cui ebbe a procedere il Moro. Dopo quell' epoca che ho suindicato non accedei più alla casa del Moro, ne so se nell' esecuzione de' suoi lavori esso sia dedito a truffe. Preletto e confermato, giurò, si sottoscrisse

[firmato] Francesco Pajaro
Barbaro
Ferruzzi

Notes

1 My thanks to Liz James for inviting me to her conference. She asked that my topic be related to the *Corpus* for wall mosaics in the North Adriatic area (see n. 2 below) and when I gave her a choice between fake mosaics in museums and the typology of 11th-century angels, she chose the former subject. Since that time, I have also developed the latter subject, which is to be presented in September 2012 in Venice at the XVII AIEMA colloquium under the title 'Inside the eleventh-century mosaic workshop of Torcello's west wall'. My thanks also to Chris Entwistle, who prepared this text for publication with courtesy, good humour, patience and great effectiveness.

2 For the *Corpus*, and its beginnings, see I. Andreescu, 'The Corpus of wall mosaics in the North Adriatic area', *Bulletin de l'AIEMA* VII (1978), 317–23. Publications based on the research for the *Corpus* include: I. Andreescu-Treadgold, 'Il Corpus dei mosaici parietali nella zona nord Adriatica e la campionatura delle tessere vitree del III registro della parete ovest a S. Maria Assunta di Torcello (I)', in *IX Colloquio dell'Associazione Italiana per lo Studio e la Conservazione dell'Mosaico (AISCOM) Aosta, 2003*, Ravenna, 2004, 175–90; eadem, 'Il Corpus dei mosaici parietali nella zona nord Adriatica e la campionatura delle tessere vitree della parete ovest a S. Maria Assunta di Torcello (II): gli altri registri', in *X AISCOM Lecce, 2004*, Ravenna, 2005, 617–36; and I. Andreescu-Treadgold and J. Henderson, 'Glass from the mosaics on the west wall of Torcello's basilica', *Arte Medievale* 2 (2007), 87–140; I. Andreescu-Treadgold, 'The mosaics of Venice and the Venetian lagoon: thirty-five years of research at Torcello', in *La mosaïque byzantine et sa diffusion (X^e-XIIe siècles): travail, techniques et matériaux (Acts of the Session at the 22nd Byzantine Congress Sofia 2011)*, forthcoming.

3 I. Andreescu-Treadgold and J. Henderson, 'How does the glass of the wall mosaics at Torcello contribute to the study of trade in the 11th century?', in M.M. Mango (ed.), *Byzantine Trade (IV-XII centuries): The Archaeology of Local, Regional and International Exchange*, Farnham, 2009, 393–417, esp. 399–400, n. 11.

4 *Cf.* H.C. Evans *The Arts of Byzantium*, reprint of *The Metropolitan Museum of Art Bulletin*, Spring 2001, Vol. LVIII, nr. 4: 'Mosaic Head of Christ; Glass; Byzantine; Made 1100–1200; 11 3/8x8 1/4 in. (28.9 x 20.9cm.); Lent by Mary and Michael Jaharis' reproduced in colour on p. 40, entry by H.E[vans].

5 G. Mietke (ed.), *Das Museum für Byzantinische Kunst im Bode-Museum*, Munich-Berlin-London-New York, 2008 (2nd edn), 24; entry by A[rne] E[ffenberger].

6 Not all curators in these museums accept the opinion, which in my view is correct, that fakes can enter large museum collections, even though these have sometimes been built over several hundred years. This is however the position of Jannic Durand at the Louvre, who supplied me with the museum's information for the two fake mosaics purchased by his predecessor Étienne Coche de la Ferté in the 1950s, for which I thank him here. Paul Williamson at the Victoria & Albert Museum allowed me to visit the large storage building where the Museum keeps several copies of mosaics. In fact, John Beckwith, his predecessor there, asked me very long ago specifically for my opinion on the head which I have since identified as the head of Christ from San Michele in Africisco (see below, pp. 280–1 and **Pl. 27**). At the Hermitage, however, whose still unpublished collection of mosaics (most of them not original), I saw in 1991, Yuri Pyatnitsky (to whom I gave my opinions freely at the time of my visit) took a different view when I contacted him for permission to publish some of my notes of twenty years ago (my email of 28 July 2010, his answer also by email of 29 July 2010): 'So you have not permition to publishe photoes from the Hermitage mosaics and also information about these still unpublished items'. Announcing the publication of his own catalogue for 2012, he informs me, 'of course I included your opinion in my catalogue'. (sic!).

7 See the discussion below and n. 20.

8 Not having yet received an answer from Mrs Jaharis to my request for permission to publish my own photographs of her piece, I am using the figure published in the *MMA Bulletin*, with numbered 'windows' indicating the parts specifically discussed.

9 Email to Irina Andreescu-Treadgold 7 Sept. 2005: 'In regard of the Jaharis-mosaic I am not willing to go further into this matter. You

should understand that some informations given verbally are not supposed to be printed. Why should I expose or cause possible problems to people who never did any harm to me (or to you)? I am always prepared to assist scholars in order to solve scientific questions if I can. But your questions ('Which gallery? When? Which price') have nothing to do with science or scholarship; they are the concern of the art market and of art critics writing for newspapers and art magazines.'

10 On the practice of reusing tesserae, see Appendix A, above, (Archivio di Stato Venezia, Presidenza Luogotenenza lombardo – veneta, B. 390: Processo Moro, 'Giornale del processo pendente presso l'I. R. Cons. nob. Barbaro contro Giovanni Moro arrestato') items 12, 15 and 16, all unpublished, and e.g. I. Andreescu-Treadgold, 'Moro, Salviati, and the mosaics of Sant'Ambrogio in Milan', *Studi Veneziani* 33 (1997), 197–230, esp. 200–1, n. 15; for the practices of mosaic restoration in the 19th century at San Marco, see the deposition of G.B. Meduna in Appendix A, above, items 12 and 16, both previously unpublished. Specifically for the Jaharis mosaic, if any tesserae were tested and declared not to be non-modern (see above, p. 271 and n. 3), it would be in keeping with good scholarly practice to identify the tesserae tested, to indicate the criteria for their selection, and then to communicate the methods used and the results of the tests.

11 G. and M. Soteriou, *He basilike tou Agiou Demetriou*, 2 vols, Athens, 1952, 192 and pl. 62.

12 Unfortunately, lacking the institutional support with which it started, the *Corpus* has become a private project which I have been able to complete for one monument only, the church of Santa Maria Assunta at Torcello; even so, its illustration section has not been made available online or otherwise because, again, of the costs necessary for an appropriate preparation.

13 For Moro's 'antiquing' of mosaics, both to conceal their real provenance and to make them more convincing for the collector, see I. Andreescu-Treadgold, 'Giovanni Moro and a new apostle head from Torcello', *Arte Medievale n.s*, XI. 1–2 (1997), 199–214, esp. 208, and n. 47.

14 My thanks to A. Drandakis, to whom I owe the information on the piece's publication status (Inv. nr. 20624). The Museum's label does not suggest a date for it, but dates the better known fragment of the Virgin's head from Stoudios to the late 10th century. Both fragments share a greenish-yellowish glass used for shadowing the faces (for this fragment, a few tesserae are present in the eyebrow). Such glass is also present in Hagia Sophia, Istanbul in the imperial panel of Constantine and Justinian as well as in the Leo VI panel.

15 The illustration is taken from O. Demus, *The Mosaics of San Marco*, I,2, Plates, Chicago-London, 1984, pl. 36.

16 The picture was scanned by Marlia Mango, to whom many thanks, from G.A. Salles and D. Lion-Goldschmidt, *Collection Adolphe Stoclet*, Brussels, 1956, pl. 23.

17 The ex-Stoclet Christ was sold at auction not once, but twice. I saw it in 2005, courtesy of a collector who had bought it 'on approval'.

18 B.F. Cook, 'A fake porphyry head', *Burlington Magazine* 126 (1984), 18–20.

19 A recent article on the front page of *The New York Times* (20 June 2012: P. Cohen, 'In art, freedom of expression doesn't extend to "is it real?"') has covered the dangers incurred by specialists who discuss fake pieces. If this were to happen about the Jaharis Christ, I would present the very detailed technical dossier of the piece!

20 I have published two extensive articles on this mosaic. The first, in 1990, 'The wall mosaics of San Michele in Africisco, Ravenna, rediscovered', in *Corso di cultura sull'arte ravennate e bizantina* 37 (1990), 13–57 announced the discovery of a few relevant original fragments – among them the Christ from the Victoria & Albert Museum (mentioned above in n.6), which I identified as belonging to the church of San Michele in Africisco in Ravenna; my article reviewed critically the previous literature on the subject, which had almost unanimously assumed the mosaics in Berlin to date from the mid-6th century; I postulated that the mosaics in Berlin were the work of Giovanni Moro from 1850–1. The second article, published in 2007, 'I mosaici parietali antichi e quelli ottocenteschi di S. Michele in Africisco: l'analisi filologica', in C. Spadoni and L. Kniffitz (eds), *San Michele in Africisco e l'età giustinianea a Ravenna* (conf. proc. Ravenna 2006), Milan, 2007, 113–49, illustrated the mosaics in colour (which was not available in the first publication), contrasting the originals and their copies by Moro, i.e., the apse in the Bode Museum; it also presented the technical analysis of the original mosaics in collaboration with Julian Henderson, who analyzed several glass tesserae from the three original fragments. Unfortunately and unknown to us, because of a misguided decision by the editors, our contributions were separated in the publication and lost their original cross-referenced format. Another poor editorial decision lumped together in a fascicule the colour illustrations of all the articles in the volume, and separated them from the black-and-white illustrations, rendering the references hard to follow, while removing some of the black-and-white illustrations altogether from the article and moving them to another section for no intelligible reason. To avoid the problem of permissions, in the present publication I have used photographs already published, thus in the public domain: the overall view of the Berlin apse in the museum's own guide (see n. 5, above) on **Pl. 12**; the cover of A. Effenberger's first edition of his publication of the mosaic from 1975, *Das Mosaik aus der Kirche San Michele in Affricisco zu Ravenna*, Berlin, **Pl. 13**; the one from his second edition from 1989 (**Pl. 14**); the invitation for the presentation of the volume *San Michele in Africisco e l'età giustinianea a Ravenna* in 2007 (**Pl. 15**); and some of my own close-ups of the mosaics, already published in the 2007 Acts volume, cited above. Among later authors, the best summary of San Michele's reassessment was published by D.M. Deliyannis, *Ravenna in Late Antiquity*, Cambridge, 2010, 252–3: 'The mosaics of San Michele have a remarkable history. Upon their removal from Ravenna in 1844, they were taken to Venice, where the mosaic restorer Giovanni Moro made a reproduction based on drawings and some original fragments. In 1904 this restoration was installed in the Kaiser-Friedrich-Museum in Berlin (now called the Bode Museum), where it remains today (Fig. 89). The only surviving original fragments from this church are the heads of the two angels now in the Museo Provinciale in Torcello and the head of a beardless Christ in the Victoria and Albert Museum in London. The mosaics in Berlin were, for most of the 20th century, considered to be restored originals, and only a study by I. Andreescu-Treadgold in 1988 revealed that the entire work in Berlin was a reproduction.'

21 O. Wulff, 'Das ravennatische Mosaik von San Michele in Africisco im Kaiser-Friedrich-Museum', *Jahrbuch der Preussischen Kunstsammlungen* 25 (1904), 374–401.

22 Referred to above, in n. 20.

23 See Effenberger 1975 (n. 20) and idem 1989 (n. 20).

24 See Mietke (n. 5).

25 C. Gramentieri, 'Il mosaico absidale di San Michele in Africisco: inediti d'archivio', *Ravenna studi e ricerche* 2 (1995), 85–101 and eadem, 'Il mosaico absidale di San Michele in Africisco attraverso le antiche riproduzioni iconografiche', in Spadoni and Kniffitz (n. 20), 337–48.

26 I am surprised that she never consulted these fascicules, but mine was the only signature in the folder's register, once in 1992 and next, 19 years later almost to the day, in 2011. Despite citing several times the article by O. Wulff, who in 1904 chronicled the entire history of the apse from the museum's internal archives, Gramentieri seems unfamiliar with Moro (whom she calls 'Francesco' rather than 'Giovanni').

27 Wulff (n. 21), 385 and 389. Jordan's discovery in October 1875 that Moro's mosaic sections ('Mosaikausschnitte'), now damaged after their 25-year-long stay in the original crates, showed underdrawings, had raised suspicions; Wulff's report mentions that: 'Jordan, der die beiden [mosaic] Köpfe […] darauf vom vorgeklebten Papier befreien ließ, fand auf diesem eine Vorzeichnung derselben und folgerte daraus mit Recht, daß die Unterlage nicht mehr die ursprüngliche sei'. I myself have not read the 'Jordan' file, because I used my time in Berlin for the early period of the history of San Michele in Africisco, awaiting the digitalization of the Berlin Archives, announced for the fall of 2011. But Wulff's account on the matter is very clear, though his explanation of these modern underdrawings is forced. Wulff believed that Moro had made new underdrawings, to which he painstakingly applied the original mosaic tessera by tessera as per

his contract, which stipulated that the old and new parts of the mosaic should be completed and blended in ways that would not allow observers to tell them apart (Zentralarchiv der Staatlichen Museen zu Berlin, I, FBS 3, ff. 296–7, unpublished, f.296/ r/v: 'Il Sig.r Moro si obliga di eseguire il completo ristauro del detto Mosaico tanto nella parte piana come nella parte concava, conservando a questa la forma originale di catino, ripristinandone a buona regola d' arte con nuovi pezzi tutte le parti, si quelle la cui mancanza è apparente, come quelle che già in altri tempi furono supliti con dipinture, conformando le nuove parti alle antiche tanto nella tecnica loro costruzione quanto nell' effetto artistico, con imitare siffattamente il disegno, le tinte, o/ lo stile di quell'opera, che non se ne possano poi discernere le parti ristaurate dalle antiche'; unpublished). This task proved impossible, and we shall see below how Moro got out of this unrealistic requirement. The mosaics were transferred to new paper supports by the Salviati company, and the receipt for this operation is dated 28 May 1878 (the amount paid to Salviati was 1500 marks). Later still, the restoration company Puhl & Wagner made another underdrawing for their transfer of the mosaic.

28 Spadoni and Kniffitz (n. 20).

29 It is – so to speak – a photographic or ghost-like copy of the original mosaic. All the tesserae of the original, one by one, are present in the coloured rubbing. This is how a particular forger should go about it, if only given access to the calco.

30 For Moro's use of materials see I. Andreescu-Treadgold, 'Prolegomena to a biography of Giovanni Moro, Venetian mosaicist-restorer of the nineteenth century', *AISCOM* VI (1999), 67–80; eadem (n. 10), 197–230, and eadem (n. 13).

31 Andreescu-Treadgold and Henderson (n. 2): compare apostle A2 on Torcello's west wall, the original (pl. 22) and Moro's copy of the same (pl. 24).

32 Zentralarchiv der Staatlichen Museen zu Berlin, I, FBS 3, ff. 296–7, unpublished.

33 Moro's contract of 1848 for the restoration of mosaics at Torcello specifies: '4.o. Sarà poi rilasciato gratuitamente il materiale risultante della demolizione delle parti del Mosaico vecchio de rinnovare, [emphasis added] ed egli d'altronde dichiara che non sarà mai per pretendere alcun indennizzi per le spese di trasporto e di viaggi che dovesse incontrare da questa Città in Torcello.' (*cf.* Archivio di Stato Venezia, Presidenza Luogotenenza lombardo – veneta, B. 390: Processo Moro, 'Giornale del processo pendente presso l' I. R. Cons. nob. Barbaro contro Giovanni Moro arrestato'.) item 15, and I. Andreescu, 'Torcello I. Le Christ inconnu; Torcello II. Anastasis et Jugement dernier: têtes vraies, têtes fausses', *Dumbarton Oaks Papers* 26 (1972), 183–223, Appendix 1, 207–8.

34 Moro's judicial troubles had been known to me for decades, mostly through partial evidence, when some years ago I came across the entire dossier of his trial at the Archivio di Stato in Venice, a very large and fascinating file. It is rich with information on many levels, especially about mosaic-making practices, with detailed references to materials used, to prices, to the practices used in restorations, and to the institutions involved in the supervision of the artisans. Despite the large amount of time needed for processing the archive – it runs to over one thousand pages – I hope to publish much of it and to illustrate the written information with numerous illustrations taken from the mosaics themselves.

35 The wooden form generated correspondence for years to come, along with Moro's requests for additional back storage fees: see Moro's unpublished letter to Treves of 22 July 1851 about the wooden form which he wanted to return now that his work had been finished (end of March 1851), and which he had not used because it did not match either the measurements on the drawings he had received initially from D'Olfers (the Director of the Royal Museums in Berlin) or the dimensions of the mosaic pieces removed from Ravenna (Zentralarchiv Staatliche Museen zu Berlin – Preußischer Kulturbesitz, I/FBS 3, f.347/345, unpublished). In 1862, the wooden form was still unclaimed by the Prussian party and Moro would demand back storage fees for it (ibid., f.351/349, unpublished).

36 It may be possible to locate at the archive in Berlin at least one of these reports sent by Pajaro in 1851, with full details on this matter, one hopes (though no such report is mentioned in the article of 1904 by Wulff [n. 21], who read the entire folder).

37 See n. 26.

38 Moro used his own new materials – the rather reduced palette was the same for both the San Michele commission in 1851 and the mosaics in Torcello, between 1853 and 1856; he obviously was not bothered by the different palettes that characterized the six centuries between the two decorations; *cf.* Andreescu-Treadgold (n. 13).

39 Andreescu-Treadgold 1999 (n. 30), 67–80.

40 I. Andreescu, 'Torcello III. La chronologie relative des mosaïques pariétales', *Dumbarton Oaks Papers* 30 (1976), 245–341, esp. 303–5.

41 Andreescu-Treadgold 1990 (n. 20), 39; L. Kniffitz, 'Alcune considerazioni sulla testa del Cristo conservata al Victoria and Albert Museum di Londra', in Spadoni and Kniffitz (n. 20), 165–77.

42 R. Cormack and M. Vassilaki (eds), *Byzantium 330–1453* (exh. cat., London), London, 2008, cat. no. 222, 246, 435–6.

43 Andreescu (n. 33); Andreescu (n. 40); for a summary of his activities, chiefly in Venice, but also in Milan's Sant'Ambrogio: eadem (n. 30).

44 Salviati professed a methodological belief in replacing old mosaics with new, 'identical' ones: for his own written statement, preserved in the archives at Sant'Ambrogio in Milan, where in 1863 he bid (unsuccessfully) for the restoration of San Vittore in Ciel d'Oro (the members of the Commissione pel Restauro of the church were horrified at his suggestion about destroying their old mosaics): see Andreescu-Treadgold (n. 10), 197–230, esp. 222–5.

45 The archives of the Salviati Company which in the 19th century was active mostly in Venice and England in several glass ventures, including contemporary decorations but also restoration of mosaics, have been entirely lost, it seems in the Second World War. Still, some of the activities of the firm can be reconstructed in other ways, through numerous places where Salviati had commissions. There are abundant archival documents at Windsor Castle connected with the Albert Memorial (Salviati produced the glass for the mosaics and the bossed gems) and the Frogmore Royal Mausoleum, partly published by Teresa Sladen in C. Brooks (ed.), *The Albert Memorial*, New Haven and London, 2000, 286–307; for a recent volume dedicated to Salviati's modern commissions with very good coloured illustrations of many of his mosaics, *cf.* S. Barr, *Venetian Glass Mosaics: 1860–1917*, Woodbridge, 2008. But for the Byzantine mosaics and their restoration, by far the most important collection of documents is in Venice and concerns Salviati's long-term connection in various capacities with San Marco. Unfortunately, the staff at the Procuratoria di San Marco has neither published the documents properly nor granted access to other scholars to do the work.

46 I. Andreescu-Treadgold, 'Salviati a San Marco e altri suoi restauri', in E. Vio and A. Lepschy (eds), *Scienza e Tecnica del Restauro della Basilica di San Marco*, Venice, 1999, 484–7; for a chart of restorations on the west wall in Torcello (with the exception of the top gable, omitted from the published photograph, but entirely remade by Salviati), *cf.* Andreescu (n. 40), fig. 1.

47 Andreescu-Treadgold forthcoming (n. 2).

48 See n. 2.

49 See R. Cormack, 'An apostle mosaic from medieval Torcello', *Sotheby's European Works of Art, Sculpture and Metalwork. Sale cat. London, Thursday July 9th, 1987*, London, 1987, lot 64 (separate catalogue).

50 The details of the circumstances of the mosaic's leaving Venice have not yet been researched and uncovered in the archive of its first British owner, G.T. Clark, who had it put above his wife's grave in the church in Talygarn after 1885, when Clark rebuilt the church. Though Clark's 'diaries from 1867 to 1884 are not yet investigated' (Cormack n. 49, 9), enough is known both about Clark's dealings with the Salviati Company, and about the style of the modern head replacing it on the west wall, to connect the head with one of the mosaicists who had worked at Torcello in 1871–2, rather than with Moro: I. Andreescu-Treadgold, 'The real and the fake: two mosaic heads from Venice in American collections', *Studi Veneziani* 36 (1998), 279–300 and figs 2a–c (2b, reproduced above as **Pl. 33**, shows the chart of the head's restorations).

51 I. Andreescu-Treadgold, '293. Two mosaics from a Last Judgment composition', in H.C. Evans and W.D. Wixom (eds), *The Glory of*

Byzantium: Art and Culture of the Middle Byzantine Era, AD 843–1261 (exh. cat., New York), New York, 1997, 452–3 (catalogue entry).

52 In 2006, this new original angel's [half-] head surfaced at the Sèvres Musée National de la Céramique and was exhibited in Venice in 2009: G. Caputo and G. Gentili (eds), *Torcello: alle origini di Venezia tra Occidente e Oriente* (exh. cat., Venice), Venice, 2009, cat. no. 17, 64 and 165, by M. P[ic].). Both this mosaic and the Louvre angel just mentioned, brought to France by the same E. Gerspach, were made in the 11th century by the same artisan and in my opinion occupied originally contiguous places on the wall (TO, SMA, W III, a11 and a12).

53 Andreescu-Treadgold (n. 46), 502–6 and Andreescu-Treadgold (n. 50), 289.

54 Worse still, despite my settling for just the photograph of the angel in the catalogue's comparanda, the person in charge of identifying the objects from Italy to be photographed for the occasion came back with a photograph of another, wrong angel (though from the same museum), a mosaic that in its day had been removed from a different part of the building and which dates from the 12th century, a century later than the original group! It appears in the exhibition's catalogue on p. 453 for no reason connected with the subject matter.

55 See n. 44.

56 Moro too had used original heads as gifts: among the examples (if we leave out the V&A San Michele Christ, who was acquired for a modest sum) is an angel head from Torcello's Last Judgment mentioned in a report concerning the restorations at San Giusto in Trieste in 1866. The mosaic head was brought as a good will gift by Moro who hoped to secure his selection for the job. But the commission did not come Moro's way and the mosaic head was turned in by the functionary who had received it (G. Bernardi, 'I mosaici di S. Giusto a Trieste. Documenti per la storia dei restauri (1850–1950)', in *Atti e Memorie della Società Istriana di Archeologia e Storia Patria*, n.s., XLIV (1996), 30–1: 'Essendo stato gentilmente favorito dal sunominato Artista [Moro] con un pezzo di mosaico ristaurato per il Duomo di Torcello, il sottoscritto si fa un pregio di rimetterlo sub:/: a quest'Inclita Autorità per l'opportuna disamina…', Trieste, Biblioteca Civica, Archivio Storico (T.B.C.-A.S.), F 5/3 2 26 giugno 1856). Unfortunately, my attempts to retrieve it at Trieste have been unsuccessful (I thank Grazia Bravar, former director of the Museo Civico for having conducted a search for the head in the museum's storage rooms).

57 I have discussed both mosaics in Andreescu-Treadgold (nn. 46 and 50).

58 G. Millet, *Le Monastère de Daphni*, Paris, 1899, in his preface, ix–xi, tells the then recent story of the mosaics' repairs and specifically mentions a certain Novo, a Venetian mosaicist who allegedly had headed the Salviati team in Venice for 22 years. G. Gerola, 'La tecnica dei restauri ai mosaici di Ravenna', *Atti e memorie della Regia Deputazione di Storia Patria per le provincie di Romagna*, Serie IV (1917), 101–98, mentions the mosaicist Carlo Novelli born in Ravenna in 1843, who trained in Venice starting in 1881, and left for Greece for a short commission from the Greek government in 1889 to work at Daphni before returning to Ravenna (p. 176). As shown by R. Cormack in his 'Rediscovering the Christ Pantocrator in Daphni,' *Journal of the Warburg and Courtauld Institutes* 71 (2008), 55–74 Novelli and the [Francesco] Novo mentioned by Millet, though both Italian mosaicists, were distinct persons. Recently, there have been several announcements about publishing the archival documents concerning the restoration at Daphni; *cf.* A. Paribeni, 'From Ravenna to Athens: Italian restorers of the mosaic of Daphni at the end of the 19th century,' *XII Colloque de l'Association Internationale pour l'Étude de la Mosaïque Antique (AIEMA) 11–15 september 2012 à Venise*, Venice, 2012, and D. Chrysopoulos, 'I mosaici di Dafni: restauri antichi e recenti come fonte di informazione sul cantiere e le tecniche', *Table ronde. La mosaique et sa diffusion (XI–XII siècles)*, Sofia, 2011, 22 (Byzantine Congress: Acts of the Round Table).

59 Most of the copies – Moro's and Salviati's – were removed from the wall in 1896 (*cf.* Andreescu (n. 40), 306–12) and have been stored in one of the basilica's adjacent rooms, a sacristy in the 'quarta navata', where they are today in a state of neglect and disrepair (**Pl. 42**); some have disappeared even since 1975 when they were first photographed by Ekkehardt Ritter during my first Torcello campaign.

60 From the 1848 contract, as in n. 33, above, unpublished: '4.o Nella detta superficie saranno levati gli smalti, e separati, dopo aver eseguiti i Cartoni piccoli a colori, ed *i Cartoni grandi a semplici contorni* (emphasis added). Sarà poi scrostato il muro, bene nettate le Commissure delle pietre e poste le scalette d' intonaco a calce e terrazzo sulla muratura bene adequata. Per ultimo si stenderà il cemento di calce di cogolo e polvere di Rovigno in parti eguali, nel quale saranno posti li smalti'.

61 Among this type of crown used in Middle Byzantine mosaics, the most detailed one is that of Constantine IX in the Zoë panel, where the pearls in the crown and in the side strings of the *praependulia* are each of different sizes and completely independent of each other. The strings of pearls end in an expanded tassel made with pearls of several sizes and shapes (the largest are cut from one piece and tear-shaped). The royal crowns in Hosios Loukas (David, Solomon and Constantine) also clearly distinguish visually between the pearls set on the crowns and the strings of *praependulia*. At Nea Moni, the kings in the Anastasis are represented in a more schematic version, in which the pearls in the sections of the crowns and *praependulia* seem to continue each other (especially when seen from a distance), though the sections of the gold crowns are in fact studded with pearls distributed in patterns of five (rather than in straight rows) and do not connect with the vertical rows at the sides (this pattern appears at Hosios Loukas in Constantine's crown). At Daphni, by contrast, the crowns of the Prophet Kings (both in the cupola's drum and in the Anastasis) are not accompanied by any hanging *praependulia*. At Torcello, the original string of pearls, their size the same as that of those in the crown – all round and likely sliced from a round shaped rod – has been preserved today only to the end of David's hair (**Pls 40a, 41**): it must have continued below David's ear level ending in an emphasized, jewelled tassel. Unfortunately, the green halo we now see was remade almost entirely, possibly by Moro, but more probably in 1872–3, and the end of the original *praependulium* set against it was lost in the process.

62 See also J. Walsh, 'Eight theses for art historians and museums', *College Art Association News: Newsletter of the College Art Association* 24, no. 2 (1999), 10–12.

63 'Panel VIII.4 Fakes', (Co-ordinator A. Cutler) in E. Jeffreys (ed.), *Proceedings of the 21st International Congress of Byzantine Studies. London 21–26 August 2006. Volume II: Abstracts of Panel Papers*, Aldershot, 2006, 290–4.

64 Ibid., 292.

65 The *Corpus* survey for Daphni in 1976 produced the visual evidence needed for the assessment of its mosaics, including the Pantocrator in the dome; the data offered by Cormack's analysis of historic photographs (as in note 58), while part of the process, is nevertheless decisively improved by the examination of the transparencies taken of the mosaics, the former enhanced by high resolution scanning. This information could have been made available to the scholarly community decades ago had it not been for the default of Dumbarton Oaks on the project.

66 'Panel VIII.4 Fakes' (n. 63), 294.

67 Swifter action was taken by the Metropolitan Museum a few years ago in the case of the modern ciborium arches sculpted in Longobard fashion (*cf.* B. Brenk, 'Four Langobardic marble reliefs recently acquired by The Cloisters', in E.C. Parker with the assistance of M.B. Shepard (eds), *The Cloisters: Studies in Honor of the Fiftieth Anniversary*, New York, 1992, 63–85; and, 'Five arcuated lintels', in W.D. Wixom (ed.), *Mirror of the Medieval World* (exh. cat., New York), New York, 1999, cat. no. 68, 53 (TBH[usband]) by a very contemporary artisan (Giovanni Rizzardi, b. 1937, who, it seems, was not even trying to deceive anybody about his wares; *cf.* E. Napione, 'Marmorai veronesi e scultura medievale: il caso degli archetti di ciborio del Metropolitan di New York', *Verona illustrata: rivista del Museo di Castelvecchio* 13 (2000), 81–9, figs 96–104): the pieces now appear in the online Museum catalogue as 'Arcuated Lintels, early 1980s'.

Chapter 27
Alexandria on the Barada
The Mosaics of the Great Mosque in Damascus

Judith S. McKenzie

For Julian Raby

Introduction

The prophet Muhammad died in AD 632, and by AD 661 the Umayyad court and administration were established in Damascus, on the Barada River. It soon became the official capital of the Umayyad Empire. Because of the wealth and tax revenues of the vast lands conquered by the Muslim Arabs, the Umayyad treasury was able to finance an impressive imperial building programme. Consequently, the early Islamic religious buildings built in the late 7th and early 8th centuries lavishly decorated with expensive glass wall mosaics, include the Dome of the Rock in Jerusalem and the great Umayyad mosques of Jerusalem, Medina and Damascus. The caliph Abd al-Malik (AD 685–705) used the tax revenues of Egypt for seven years to pay for the Dome of the Rock in Jerusalem, while his son al-Walid I (AD 705–15) used the land tax of Syria to build and decorate the Great Mosque in Damascus. Only these two buildings survive, and retain a notable percentage of their original Umayyad mosaic wall decoration.

The mosaics of these two buildings are distinctive for their colours and technical details (blue-green decoration with gold background with highlights of red and, especially where there is low light, mother of pearl). Their iconography has features in common including extensive use of classical acanthus scrolls, plant candelabra, and naturalistic trees, as well as a total lack of any figures or animals (including birds or fish). However, there are also significant differences. Those on the Dome of the Rock have Sasanian features, such as wings on the plant candelabra and stylized trees with lotus or tulip-shaped flowers. By contrast, these elements are lacking on the mosaics of the Great Mosque, which have extensive depictions of buildings and a river. The artistic source of these and how they relate to the meaning of the mosaics is the focus of this paper.

The details of the workmanship of the mosaics on both buildings are so similar that Marguerite Gautier-van Berchem, who examined both closely first hand, identified them as the product of the same workshop of workmen, whom she considered to be Syrian, and argued that the river depicted was the Barada.[1] Mab van Lohuizen-Mulder suggested that, because of their iconography, the mosaics of the Great Mosque in Damascus were made by Alexandrian mosaicists with the help of Syrian workmen, and the Aphrodito papyri written at the time mention that skilled workmen (but not specifically mosaicists) were sent from Egypt to work on it.[2] Other scholars have suggested a major role for mosaicists from Byzantium in their creation, influenced by Arabic texts, although these do not first mention this until over four centuries after the mosaics were created, as demonstrated by Gautier-van Berchem.[3] Finbarr Flood describes his book on the Great Mosque as one 'about the relationship between the art and architecture of two hegemonic cultural centres: Constantinople, the fabled capital of Byzantium, and Damascus, the ancient urban centre of southern Syria adopted as the seat of the Umayyad caliphate'.[4] Alexandria, although not an imperial capital, remained a major artistic and cultural centre in the East

Plate 1 Dome of the Rock, Jerusalem, AD 691

through Late Antiquity, with an unbroken tradition going back to the Hellenistic period. Thus, its role should also be considered.

The palette of the Umayyad mosaics in both the Dome of the Rock and the Great Mosque is dominated by blues and greens for the motifs, in striking contrast to the wider range of colours used in wall mosaics further west, in places such as Ravenna, Rome and Thessaloniki. Although little known, some remains of Late Antique wall mosaics survive from Egypt and Syro-Palestine. Sites in the latter from where they were excavated include Apameia and Bosra in Syria, Bethany near Jerusalem, and Petra and Pella in Jordan.[5] Although these are fragmentary because the walls (rather than the floors) of most churches have not survived, the surviving tesserae indicate a predominance of blue and green for the patterns on a gold ground. It is usually assumed that there were no wall mosaics in Egypt. This is because they have not always been published, but they have been found at three major sites in the north, including Abu Mina, west of Alexandria, at another recently excavated large church at a major site and at Saqqara near modern Cairo. The relative quantities of the colours of the 5.5kg of mosaic cubes collected from the apse mosaic of the 6th to 7th-century Main Church at Saqqara indicate that the main colours of the patterns were opaque green glass and light blue, transparent dark blue and reddish tones, with a gold background.[6] Extensive use of blue and green is made in Egyptian art, due to the manufacture of blue-green frit, faience and glass in quantities not found elsewhere, so it is possible that this palette is Egyptian in origin, but it would also appear to have been in use in Syro-Palestine in Late Antiquity. When this evidence is considered in association with a detailed analysis of the written sources, it is possible that the mosaics in the Great Mosque could have been the product of local Syro-Palestinian and/or Egyptian designers and workmen.

This paper further explores a possible Alexandrian component in the mosaics of the Great Mosque. Based on a detailed re-evaluation of Alexandrian architecture and its depiction, especially in the Late Antique period, I have suggested elsewhere that the architecture in the Landscape Panorama mosaic in the Great Mosque is that of Alexandria. The reader should consult that discussion for more detail concerning this particular aspect.[7] This paper presents further evidence from the mosaics, including those on the north arcade which, it is shown, although made in the late 11th century, closely copy Umayyad forms, and are of previously unrecognized interest because they include a Nile boat.

Building design

Given the similarity of their mosaics, it is instructive to consider briefly the origins of the designs of the Dome of the Rock and the Damascus Great Mosque, which provide the context for their mosaics, as Syria and Palestine already had a strong local tradition of classical (Hellenistic and Roman) architecture and art which had continued to evolve in Late Antiquity.

The Dome of the Rock in Jerusalem was decorated inside and out with mosaics when it was built in AD 691 over the rock where in the Muslim tradition the prophet Muhammad began his night journey to heaven (**Pl. 1**). The mosaics on the outside have since been replaced, but most of those inside date to the original construction. Their iconographic scheme,[8] combining classical features with Sasanian ones, results in a distinctively Islamic decorative programme for a building with an innovative design.

The design of the Dome of the Rock consists of three main aspects: an octagonal shaped structure approximately 60m in diameter, with two colonnades inside it enclosing a rock at the centre, and a golden dome (on a timber frame) rising above the building (**Pl. 1**). Because octagonal buildings occur in Greek and Roman, as well as later, architecture in the West, it is often assumed that they were the source of inspiration for the design of the Dome of the Rock. However, there were already octagonal churches in the Levant in the 4th to 6th century. Archaeological evidence of surviving examples includes those at Capernaum, Caesarea and Mount Gerizim, as well as at the Kathisma Church near Jerusalem and the Church of the Ascension in Jerusalem.

In addition, the two other defining features of the Dome of the Rock are found on some octagonal buildings in Syro-Palestine, but not on those in the West. The way its golden dome is visible above the Dome of the Rock contrasts

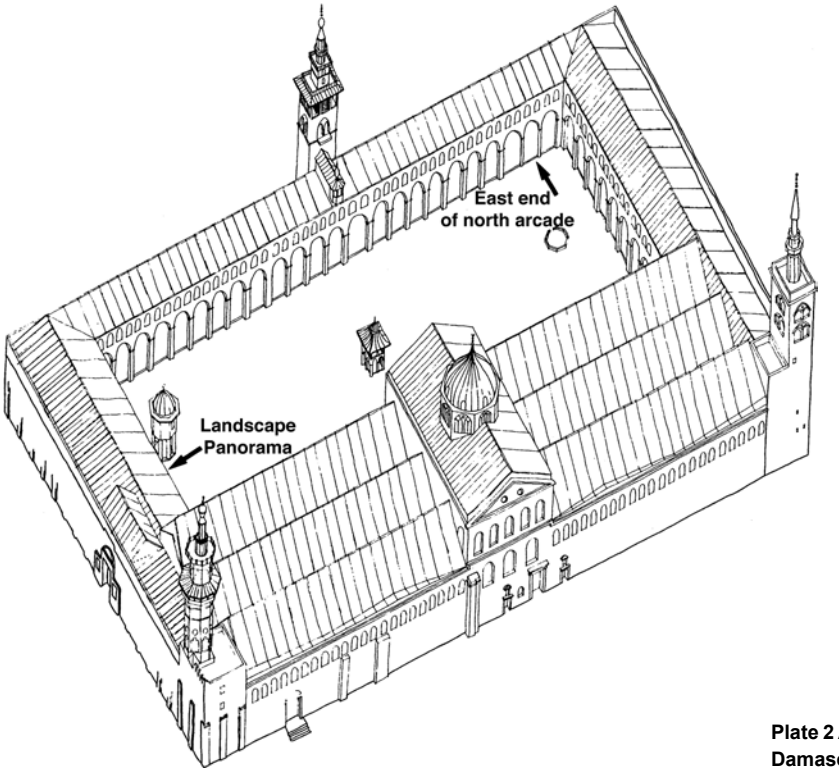


Plate 2 Axonometric reconstruction of the Great Mosque, Damascus

with the roofing of centrally designed buildings further west (both octagonal and circular) on which a tiled roof hides the dome on the outside, as on the Rotunda of St George's in Thessaloniki and the Orthodox Baptistery in Ravenna.[9] The written sources inform us that the octagonal Great Church of Antioch, built in AD 327–41, had a golden dome rising above it, as did the palace of Abd al-Aziz, the caliph Abd al-Malik's brother and governor of Egypt, built in Fustat (Old Cairo) in AD 686/7, shortly before the Dome of the Rock.[10] Excavations have revealed that, like the Dome of the Rock, the 5th-century octagonal Kathisma Church near Jerusalem had an internal colonnade around a rock – on which Mary rested en route to Bethlehem.[11] Thus, although the octagonal floor plan of the Dome of the Rock is Roman in origin, the sources of its architectural inspiration are the local versions. Like the decoration, these architectural features were combined to make a unique new building for the new religion, as outlined in the monumental inscriptions on its mosaics and on the metal plaques which originally hung above its doors.[12]

The Great Mosque in Damascus consists of a basilical prayer hall along one long side of a court with colonnaded arcades on three sides (**Pls 2–3**). The complex is built inside the former enclosure of the temple of Jupiter Damascenus, rebuilt as the cathedral of St John the Baptist, which was demolished for the erection of al-Walid's mosque. This prayer hall is reminiscent of a basilical church, with three 'aisles' of equal size running lengthwise along it, separated by arcades supported by re-used columns with Corinthian capitals with small arcades above. Whereas a church would have a single ridged roof over an emphasized centre aisle, in the Great Mosque all three 'aisles' are of equal width and height, with a ridged roof running along each (**Pl. 2**).[13] Furthermore, half way along these 'aisles' there is an internal 'transept' with a niche, the *mihrab*, in its south side marking the direction of prayer which is along the axis of this transept and across the 'aisles' (**Pl. 3**). This contrasts with basilical churches (in Syria, as elsewhere in the Mediterranean) in which the direction of prayer was along the long axis (towards the east end). In the Great Mosque, this is subverted by designing the building with the direction of prayer across the long axis.

However, Fergus Millar has noted that in the preceding period,[14] Roman imperial basilicas running along one side of a colonnaded forum usually have their main entrance midway along them (for instance, the Basilica Ulpia in Rome[15] and at Izmir[16]). Because of the similarity of the north face of the prayer hall (with the decorated façade on the 'transept') (**Pl. 3**) to the palace of Theodoric depicted in Sant'Apollinaire Nuovo in Ravenna, K.A.C. Creswell suggested that the façade was derived from a palace of such a type as might have been built in Constantinople.[17]

Plate 3 Court and prayer hall, with the direction of prayer indicated by the arrow, Great Mosque, Damascus

Plate 4 Bab al-Barid vestibule, Great Mosque, Damascus

The Great Mosque was designed to be decorated with mosaics both outside and inside, as seen in the Bab al-Barid vestibule which is still covered with them (**Pl. 4**). The architect(s) of the Great Mosque broke with classical convention in the design and construction of the porticoes around the court because their upper tier does not have a floor – it is not a balcony (**Pl. 5**).[18] Instead, the architect has used this arrangement as a way of creating a portico of adequate height to create a back wall with a 7m high canvas for mosaic scenes, such as the Landscape Panorama, lit by the windows of the upper tier (**Pl. 6**). This also suggests that the complex was planned as a unified whole integrating both the building design and decorative programme from the beginning.

This plan is repeated on other Umayyad mosques in the first half of the 8th century. For example, the mosque in Tiberias, in Galilee, is half as long. Because the outer dimensions of the Damascus mosque were pre-determined by the size of the temple enclosure into which it was built, if other Umayyad examples have related dimensions then they must have been copying it, not using some other model.

According to the written sources the earliest mosques consisted of a wide columned portico along one side of a court.[19] Later mosques have many rows of columns in the prayer hall and at least two rows of columns along each of the other sides of the court.[20] Thus, what we see in Damascus is the clever and deliberate adaptation of architectural forms and decorative media, classical (Roman and Byzantine) in origin and adapted to fit the requirements of Islamic worship, as can be observed in the Dome of the Rock. These observations should be kept in mind when considering the mosaic decoration.

Mosaics of the Great Mosque in Damascus

When the Great Mosque in Damascus was constructed in AD 706–14/15, all of the walls and arcades of its court and prayer hall were decorated with mosaics on both the inside and outside, above marble panelling. Based on what survives, this decorative programme consisted of varied combinations of buildings (ornate monumental buildings or palaces and small buildings), naturalistic large trees and acanthus scrolls used in all-over decoration, friezes and plant candelabra.

Large areas of the surviving mosaics date to the original construction of the building. Repairs are mentioned in inscriptions, including those of the late 11th century under the Seljuq Tutush and in 1159 under the Zengid sultan Nur al-Din (discussed below), and those in 1269 by the Mamluk sultan Baibars who was responsible for the long inscription in the Bab al-Barid vestibule,[21] where repairs of various dates can be identified. The repairs generally copy mosaics elsewhere in the mosque and so are distinguished by their style rather than content. The most recent and extensive repairs, completed in the 1960s,[22] are obvious from their

Plate 5 Interior of west arcade, looking north, Great Mosque, Damascus

Plate 6 West arcade, with axis of the Landscape Panorama marked, Great Mosque, Damascus

Plate 7 West arcade: monumental buildings at the centre of the Landscape Panorama, Great Mosque, Damascus

Plate 8 West arcade, Landscape Panorama: tholos and two-story structure with a broken pediment, Great Mosque, Damascus

Plate 9 West arcade, Landscape Panorama: small buildings and trees to the right of the monumental buildings, Great Mosque, Damascus

bright gold background and more angular, less shaded style. The largest areas of these are on the façade of the prayer hall 'transept' (**Pl. 3**), and on the Dome of the Treasury.[23] This paper will focus on two areas of the mosaics: those on the west colonnade with the Landscape Panorama and those on the east end of the north arcade.

The west arcade and the Landscape Panorama

The largest intact area of mosaics dating back to the Umayyad period is the 34m long, 7.3m high Landscape Panorama (the 'Barada panel') which runs along the back wall of the west arcade (**Pl. 6**), to the north of the south-west entrance (**Pl. 2**). On the west arcade in front of it the lower level has rounded arches in groups of three separated by pillars and supported by reused Corinthian columns. Above each of these arches the upper tier consists of small arcades in pairs supported by small reused columns alternating with pillars (**Pl. 6**).

On the outer face of the lower level the arcades above the columns are decorated with large trees, while the two free-standing pillars have buildings depicted on them.[24] Acanthus friezes decorate the soffits of the arches (**Pl. 5**). On the upper tier where the mosaics survive above the arcades they consist of acanthus scrolls, while plant candelabra decorate the pillars. These forms with acanthus leaves are clearly ultimately derived from classical (Hellenistic and Roman) prototypes.[25] The inside walls of the arcades, and the inside walls at either end of the colonnade are decorated with trees, more acanthus scrolls and an architectural scene (**Pl. 5**).[26] The Landscape Panorama runs behind six arches, and the pillar that divides them into two groups of three is decorated with a building which marks the axis of the panorama behind it (**Pl. 6**).

The Landscape Panorama depicts large naturalistic trees,[27] ornate monumental architecture and small buildings, with a river running along the foot of the whole scene (**Pls 7–10**). Arranged around a centre axis, the disposition of the scenes on either side are approximate mirror images of each other,[28] while the monumental buildings at the centre are close mirror images of each other (**Pl. 7**). These consist of circular buildings with tent roofs (tholoi) on either side of the axis, and beside each of them there is a two-storey monumental façade (**Pls 7–8**). This has half-pediments framing a conch shell on the upper order. Moving further along, to the right and to the left, the disproportionately large trees separate these buildings as well as each group of small buildings or houses piled up a hill (**Pls 9–10**). These fill the rest of the mosaic along to both ends, with the main difference between the two halves being the scene with a monumental building and small buildings together, part way along each half.

The combination of these three types of scenes (monumental architecture, cityscapes and landscape) forming a single decorative scheme is distinctive. However, it is also used in 1st-century BC Roman wall paintings in the houses of the Bay of Naples preserved by the eruption of Mount Vesuvius. These examples are in the so-called Second Style of Roman wall painting, specifically Phase 1 of it, such as Cubiculum M of the Villa of P. Fannius Sinistor at Boscoreale (**Pl. 11**). This similarity was sufficiently striking to be noted by Eustace de Lorey when he first uncovered the scenes in the 1920s.[29] As Robert Hillenbrand noted 'the link

Plate 10 West arcade, Landscape Panorama: detail of scene in Plate 9, Great Mosque, Damascus

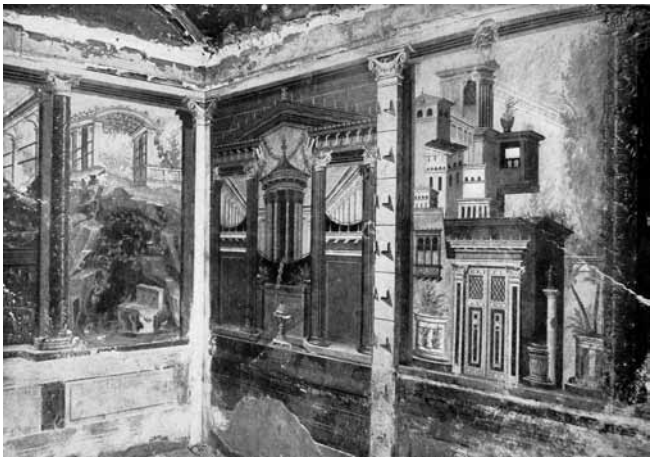


Plate 11 Cubiculum M *in situ*, Villa of P. Fannius Sinistor, Boscoreale

Plate 12 House of the Labyrinth, Pompeii, *oecus* 43, right side wall

with Roman paintings of the type found in Pompeii is unmistakable, but here the idea is put to new and unexpected use'.[30] However, the problem has always been to explain the link because of the seven-century gap between the mosque mosaics and these paintings.

The details of the scenes with the small buildings running up hills on the wall paintings and the mosaics are strikingly similar (**Pls 10–11**). In both there are tall narrow buildings with windows towards their tops. They have pitched, sloping or flat roofs. They are combined with buildings with vertical slots in them, reminiscent of wind towers.[31] These scenes also include structures with classical columns and sometimes supporting classical pediments. For example, the scene second to the right of the two-storey building on the mosaic (**Pl. 9**) includes a segmental pediment (**Pl. 10**), which is typical of Egyptian architecture going back to the Ptolemaic period.[32] In both the paintings and the mosaics, buildings are associated with some trees of similar scale to them (unlike the larger trees) (**Pls 9, 11**).

The small tall buildings with windows towards their tops in the mosaic are given a sense of perspective depth by the clever use of cast shadow. In general they are treated as if the light source is coming from the right (**Pl. 9**). This means that the symmetrical small buildings at the feet of the two tholoi are combined into a continuous scene with the use of cast shadow on them from a single direction (**Pl. 7**).

The small buildings in the mosaic differ from those in the wall paintings in one key aspect: their doorways usually have a hanging pearl in them (**Pl. 10**). These are also depicted in the monumental architecture in the mosaics in the windows and between the columns (**Pl. 8**). These pearls are used at any point of entrance.

The combination of symmetry and sophisticated rendering of cast shadow was also used in the wall paintings. In the wall paintings of the Boscoreale Cubiculum,[33] although the content of the scenes on the opposite walls are mirror images of each other, the shadow has been carefully handled by the artist(s) as if the light were coming through the window in the wall between them. This means that the shadows on the columns at the front of both reflect this (and thus they are mirror images of each other). However, when the cityscapes on each wall are mirror images of each other within one panel (on either side of the centre axis of the panel) their shadow is not treated in mirror image. Rather, the buildings in both panels have been shaded as if the light for both was coming from the window. This is similar to the way the artists in the Great Mosque mosaic run the treatment of the shadow of the small buildings across the central axis of the whole scene (**Pl. 7**). In the wall paintings the tholoi are treated with aerial perspective with the two columns at the front shaded on their sides and darker than those receding beside them, creating the curved shape (**Pl. 11**). The columns on the colonnades of the courts containing the tholoi are all shaded from the side in a row. On the Great Mosque similar use of shading is observed. The columns on the colonnades on the lower orders of the two-storey buildings are shaded from one side, but to create the effect of two symmetrical receding colonnades those on the left are

Plate 13 Khasneh, Petra

darkest on their left and those on the right darkest on their right. By contrast, the columns on the upper order supporting the conch shell are all shaded from a single side (**Pls 7–8**). Where some columns are in front of others, such as in the centre of the lower order of the two-storey building or on the tholoi, those at the front are shaded on one side and those at the back are noticeably darker (**Pl. 8**).

The monumental architecture depicted in the Landscape Panorama includes 'baroque' forms related to those depicted in Second Style painting, such as the half pediments. These are observed in the House of the Labyrinth in Pompeii, where the half pediments frame a circular structure (tholos) with a tent roof, which is in a colonnaded court (**Pl. 12**). The relationship between the House of the Labyrinth painting and the Khasneh at Petra (now known to date to the late 1st century BC or early 1st century AD) (**Pl. 13**) with their broken pediments framing a tholos with a tent roof, was noted as early as 1862.[34] Once the Landscape Panorama was uncovered the similarities were also noted between the two-storey monumental buildings depicted in it (**Pl. 8**) and the Khasneh at Petra (**Pl. 13**). Like the buildings in the mosaics it has half-pediments raked towards the back and is two storeys high.[35] I have argued elsewhere that this similarity resulted from the fact that the main influence on the 'classical' aspects of the architecture of Petra came from Ptolemaic Alexandria, where the earliest 'baroque' architecture was developed. This has generally been accepted by scholars working on Petra.[36] However, it is controversial with those who study Roman wall painting, if it implies an Alexandrian role in the origins of Phase 1 of Second Style. (It should be stressed that this suggestion only applies to Phase 1 of Second Style.) This also reflects the different perspective of those studying the East who more readily recognize Alexandria as a major cultural centre.

Notably the combination of a conch, rather than a tholos, framed by half pediments raked towards the back in the Damascus Great Mosque mosaics, does not occur on the 1st-century BC Pompeian wall paintings. The earliest example of this combination is dated to the 1st century AD, and was built in a villa at Marina el-Alamein, west of Alexandria.[37] This motif has a long continuity in Egypt and is later seen on Late Antique Egyptian churches, such as the South Church at Bawit[38] and in the mid-5th century Deir el-Abiad at Sohag.[39]

This is important because it means that the Great Mosque mosaics have new elements on them built in Egyptian or Alexandrian architecture, and not derived from the wall paintings. Consequently, the buildings depicted in the Landscape Panorama could have been derived from prototypes which continued to develop in Egypt. I found a similar picture for details of the architectural scenes in the 5th-century mosaics in the dome of St George's in Thessaloniki. For example, these have the conch shell between half-pediments; as well as peacock niche-heads which first appear in built Late Antique Egyptian architecture.[40]

Tholoi with tent roofs are depicted in the Landscape Panorama (**Pls 7–8**), but they are not in an architectural setting and are wider in proportion to their height compared with those carved at Petra and in the Roman wall paintings (**Pls 11–13**). However, examples with similar wide proportions are depicted in Gospel manuscripts of the eastern churches.[41] Analysis of the details of these (as well as those with half-pediments framing a conch), suggests a pictorial tradition in the East of the depiction of Alexandrian architecture with a number of prototypes which continued to develop in a central place, and which notably is not directly derived from the Pompeian wall paintings.[42] Examples were still being copied as late as the 15th century, with the architectural features gradually becoming increasingly misunderstood with repeated copying.[43]

This is also seen in the mosaics on the north wall of the nave of the Church of the Nativity in Bethlehem. These include panels with buildings which are clearly based on earlier models, although misunderstood through copying

Plate 14 Watercolour of mosaics on north wall of the nave, Church of the Nativity, Bethlehem

one or more times, such as the half-pediments framing a conch or circular structure (**Pl. 14**). They also include naturalistic trees and friezes of acanthus scrolls and plant candelabra.[44] Evidence uncovered in recent cleaning of these mosaics has confirmed that they are the product of local workmen and that those in the transept and on the south wall of the nave were made for the refurbishment of 1169, while the architectural register on the north wall of the nave might include work of *c.* AD 700, or otherwise represent local continuity of techniques, as well as designs.[45] Examples of such transmission are relevant when considering the mosaics on the north arcade of the Great Mosque in Damascus.

The mosaics of the east end of the north arcade

The mosaics at the east end of the north portico (location marked on **Pl. 2**) have attracted little scholarly attention, as the focus of academic studies has been largely on the Landscape Panorama. Unlike the rest of the north arcade which was re-built and, in the 15th century, given ashlar masonry supports replacing the columns (**Pl. 22**), the first three arched bays at the east end of the north arcade (**Pl. 15**) still have the same basic structure as the Umayyad west arcade[46] (**Pl. 6**) – with reused columns on the lower level and smaller columns alternating with pillars on the upper tier. However, on both levels of this part of the north arcade the arches are very slightly pointed (**Pls 15–16**), in contrast to the Umayyad examples on the west arcade which are completely rounded (**Pl. 6**). This suggests that these arches at the east end of the north arcade are not the original Umayyad ones but have been rebuilt. Therefore, their surviving mosaics must be later than the Umayyad period.

The basic iconography of these mosaics follows that used on the Umayyad west arcade (**Pl. 6**).[47] On the lower tier a fruit tree and a date palm are depicted above the columns (**Pls 15–16**), while a building is depicted above the pillar (**Pls 15, 20**). This building has a pediment with a rectangular structure below (= in front of) it (**Pls 18, 20**). Acanthus friezes decorate the soffits of the lower and upper arches and acanthus scrolls cover the areas above the upper arches (**Pls 15–16, 20**). The easternmost free-standing pillar on the upper tier is decorated with a plant candelabrum (**Pls 15, 17**), and the two pillars to its west (left) are decorated with buildings (**Pl. 15**).

The centre pillar is decorated with an ornate two-storey building with a boat floating in water at its base (in front of it) (**Pl. 16**). This building has four columns on its lower level supporting a concave entablature, with entrances between them (**Pl. 19**). On its upper level there are two domed structures at either end. The boat at the base and in front of the building is discussed below.

The details of the mosaics on the front of the colonnade above the columns and above the upper arcades suggest that they were all made at the same time. The details of the treatment of the leaves on the acanthus scrolls above the arches (with a strong centre line between them and leaves which do not taper much at the base) (**Pls 16, 20**) are identical to those on the plant candelabrum (**Pl. 17**), suggesting their contemporaneity.

The plant candelabrum is slightly clumsy (**Pl. 17**), and the rendition of the trees (**Pl. 16**) is simpler than the Umayyad examples on the west arcade (**Pls 6–7**). There is some shading on the acanthus leaves of the scrolls and the plant candelabrum (**Pls 16–17**), but the ornate two-storey building lacks any use of shading to create a sense of depth (**Pl. 19**). The articulation of its architectural components is confused, and the execution is clumsy. There are simplified conch shells on its lower order above the outer two entrances. The pedestal bases of its outer columns are depicted at two different heights. The hanging pearls in its entrances have crooked strings and are rendered in outline (compare **Pl. 19** with the Umayyad example **Pl. 8**). The decoration of the columns (representing marble) on its lower order has become a series of outlined blobs (**Pl. 19**), rather than a more complex shaded pattern of swirls (**Pl. 8**), while other columns are decorated with vertical stripes rather than shading. The most distinctive features are the use of chequerboard patterns, not found in the Umayyad examples, and the lack of any shading. The water at the foot of the building is a simplified version of the water in the Landscape Panorama which also involves more shading (compare **Pl. 19** with **Pls 7–10**). The row of rosettes immediately below the water on the north arcade pillar (**Pl. 19**) is a simplified version of the outermost band of the frame below the Landscape Panorama (**Pls 7, 9**).

Thus, although the architectural structure of the arcades and the iconography of the mosaics on the east end of the north arcade follow Umayyad prototypes, they are clearly later but copying earlier examples in the mosque; and the surviving mosaics on the front face of the arcade were all done at the same time as each other (except the inserted inscription, mentioned below).[48] These mosaics were visible in 1927 (when the Landscape Panorama was still covered by plaster), and work on them in *c.* 1954 only involved cleaning and replacing missing tesserae with tinted cement.[49]

Two inscriptions on the back wall of the north arcade mention reconditioning this wall under Seljuq rule, which lasted in Syria from 1078–1117.[50] One refers to the reconditioning of the western part of it under sultan Muhammad, son of the great Seljuq sultan Malik Shah, in 1109–10.[51] The other inscription, dated to 1089–90, mentions reconstruction of the eastern part of this wall under Tutush, brother of Malik Shah.[52]

The mosaic inscription on the pillar on the far left of the surviving mosaics on the upper level of the north arcade (**Pl. 15** far left) appears to have been inserted later into the surrounding mosaic decor on the front face of the arcade (**Pl. 20**), as Gautier-van Berchem also thought from detailed first hand examination. This inscription is dated to Nur al-Din,[53] under whom work on the mosque in 1159 is mentioned in the written sources.[54] Thus, its date provides a *terminus ante quem* of 1159 for the mosaics on the front face of the arcades.

The inserted mosaic inscription could refer to other work on the north arcade, such as the mosaics on the soffits of the two arches beside it (to its right/east) (**Pls 20–1**). The bulbous shape crowning the inscription has the same unusual combination of reddish centre surrounded by lime green/yellow, and mid-blue with a dark blue outline as used for the flower at the apex of the left/west soffit (**Pl. 21**). The acanthus leaves on these two soffits are different in style to,

Plate 15 East end of north arcade, Great Mosque, Damascus

Plate 16 Mosaics on north arcade: right half, Great Mosque, Damascus

Plate 17 East end of north arcade, upper level: plant candelabrum, Great Mosque, Damascus

Plate 18 East end of north arcade, lower level above pillar: detail of building, Great Mosque, Damascus

Plate 19 East end of north arcade, upper level: two-storey building and boat, Great Mosque, Damascus

and simpler than, those on the front face of the arcade (**Pls 17, 20**), and notably have a blue, rather than a gold, background. Nur al-Din had a lead revetment placed on the roof of the north arcade.[55]

Around the corner from this arcade, along the top of the north end of the east arcade (**Pl. 22**) there is a mosaic inscription mentioning Nur al-Din (**Pl. 23**).[56] Whilst it is possible, as Gautier-van Berchem suggested, that the mosaic directly below this inscription (**Pl. 25**) has been repaired because of its poor quality,[57] those on the nearby pillar are of better quality (**Pl. 24**) and there is no reason why they could not be contemporary with the adjoining inscription.[58] Those on the side of the pillar have a blue background, and the treatment of the acanthus leaves on their tendrils appears (from the photographs) to be related to those on the soffits mentioned on the north arcade (**Pl. 21**). Thus, this work was probably part of the repairs undertaken by Nur al-Din (1146–74), who was responsible for many other building projects.[59]

This additional evidence, from the east arcade, tends to confirm that the inscription, dated to Nur al-Din, inserted into the mosaics of the front face of the north arcade is referring to other work on that arcade, such as the soffits mentioned (**Pl. 21**), rather than to the decoration of the front face of the east end which was probably done under Tutush in 1089–90 (**Pls 15–20**).[60]

It would not be surprising for such work to have been done under Tutush. Flood has suggested that 'Tutush may have been more of a patron of Syrian architecture than has been assumed'.[61] The mosque, especially the prayer hall, was badly damaged in the fire of 1069. The Seljuq vizier of Tutush, Abu Nasr Ahmed b. Fadl, reconstructed the prayer hall roof, dome, arches and piers, as mentioned in four inscriptions.[62] Gautier-van Berchem, probably correctly, argued that the small remnant of mosaic surviving on the northwest dome-pier is part of this work.[63] She also was 'tempted' to assign the same date to the mosaics on the inner face of the courtyard wall of the 'transept'.[64] However, the column capitals on the buildings depicted in these have a 'tulip' shape,[65] rather than one consisting of acanthus leaves like those depicted in the Umayyad examples and the mosaics of Tutush on the east end of the north arcade (**Pls 8, 19**). This suggests that the surviving mosaics on the inner face of the north 'transept' wall represent slightly later renovations.

In conclusion, the mosaics on the face of the east end of the north arcade (**Pl. 15**), which include the Nile boat (**Pl. 26**), were probably made under the Seljuq Tutush in

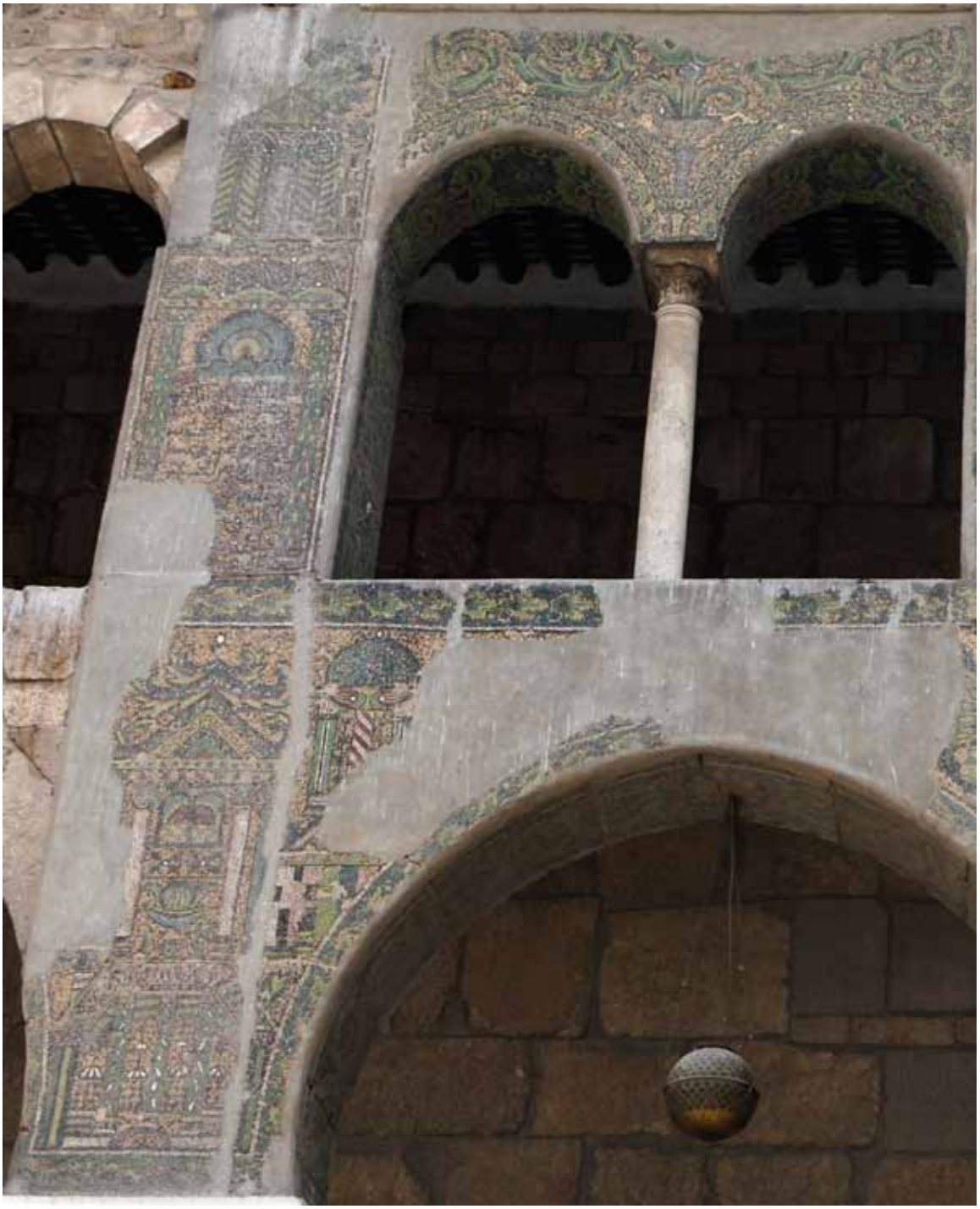


Plate 20 Mosaics on north arcade: left half, Great Mosque, Damascus

Plate 21 East end of north arcade: soffits of upper arches in Plate 20, Great Mosque, Damascus

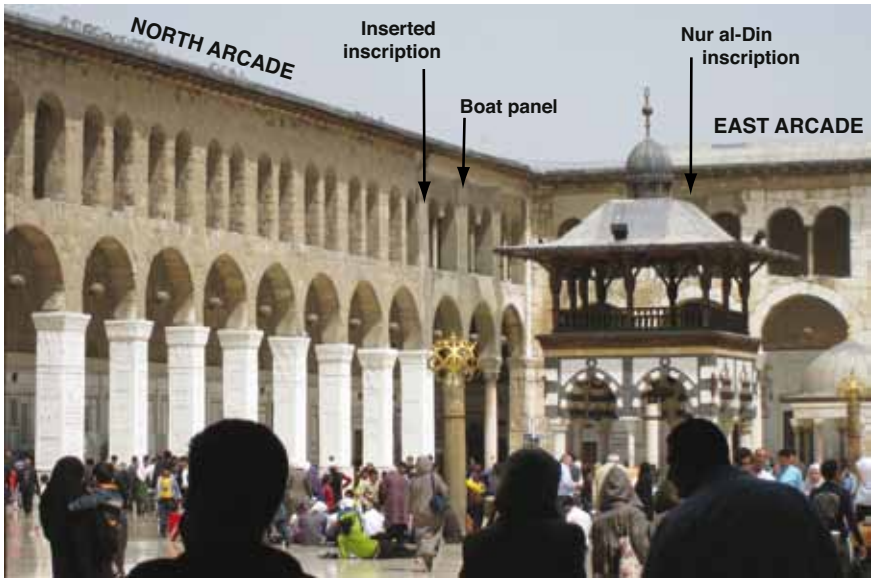


Plate 22 View to northeast corner, Great Mosque, Damascus

1089–90. As observed in the refurbishment of the Church of the Nativity at Bethlehem, there is less simplification and misunderstanding of the acanthus scrolls, plant candelabra and trees, than there are of the complexities and details of buildings with which the artists had no first-hand acquaintance (**Pl. 14**).

The boat on the north arcade

Details of the boat depicted at the foot of the ornate two-storey building (**Pls 16, 20**) on the north arcade of the Great Mosque suggest it probably also has a similar history of transmission to that of the building which is part of the same scene, in other words that it is copied from an earlier version in the original Umayyad phase of the mosaics, rather than introduced as a new element in 1089–90.

This boat has a very distinctive shape, which is typical of Nile boats (**Pl. 26**). It is flat-bottomed with its 'cargo' sitting on its deck so that the weight was spread across the shallow hull, in much the same way as on Nile barges.[66] Both the prow and stern are tall and curved a long way inwards with the stern taller than the prow, and both have an indent, like on a fish tail. It has two rudders on the stern and possibly oar-locks represented on the prow. Normally such a boat would be depicted with someone managing the rudders at the stern, and another manning the oars at the prow, as on the Praeneste mosaic at Palaestrina in Italy of *c.* 125–100 BC (**Pl. 29**). However, the figures have been omitted because they are also absent from the other mosaics in the Great Mosque. It is possible that the square with a rosette (related to those on the building above it) was used to fill some of the space which would normally have been occupied by a figure on the prow (**Pl. 26**). The hull has longitudinal markings in a number of colours, while the inward-turning prow and stern have diagonal stripes on them. The boat has a low cabin or load, discussed below, rendered in three panels of shaded chequerboard. The closest parallel for this boat depicted in a mosaic is the cabin-carrier in the Nilotic scene on the Praeneste mosaic,[67] which depicts a variety of boats including papyrus rafts (**Pl. 29**).[68]

Plate 23 North end of east arcade, upper level: mosaics with Nur al-Din inscription, Great Mosque, Damascus

The earliest Egyptian boats were rafts made of bundles of papyrus tied together, with the prow and stern curved inwards. Small examples of these continued to be used in later periods (**Pl. 29** far right), right up to the present day. The design of ancient Egyptian funerary timber boats was influenced by these so that they had a 'papyriform' shape, with a shallow hull, and a tall inward-turning prow and stern.[69] They had a series of longitudinal stripes painted along the rim of the hull, but not running onto the prow or stern. These timber boats had cabins or canopies on them covered in reeds, constructed in chequerboard or cross-hatched patterns,[70] with a flat or curved roof, as on the one illustrated in the Praeneste mosaic (**Pl. 29**).[71] The chequerboard 'cargo' on the Damascus boat (**Pl. 26**) would appear to be alluding to such a cabin, as it looks like the lower part of a cabin like the one on the Praeneste mosaic (**Pl. 29**). On the Praeneste mosaic, a second cabin-carrier is depicted with a low cabin (with a pitched! roof), but originally this was a taller cabin with a canopy,[72] before the mosaic was damaged and restored.[73] It is possible that the current form of the cabin on the Damascus boat resulted from a similar misunderstanding, especially if, as with the Praeneste mosaic repair, it involved workmen copying boats of which they had no firsthand knowledge. The Damascus boat has longitudinal stripes on its hull which, like those on

Plate 24 East arcade: detail of pillar in Plate 23, Great Mosque, Damascus

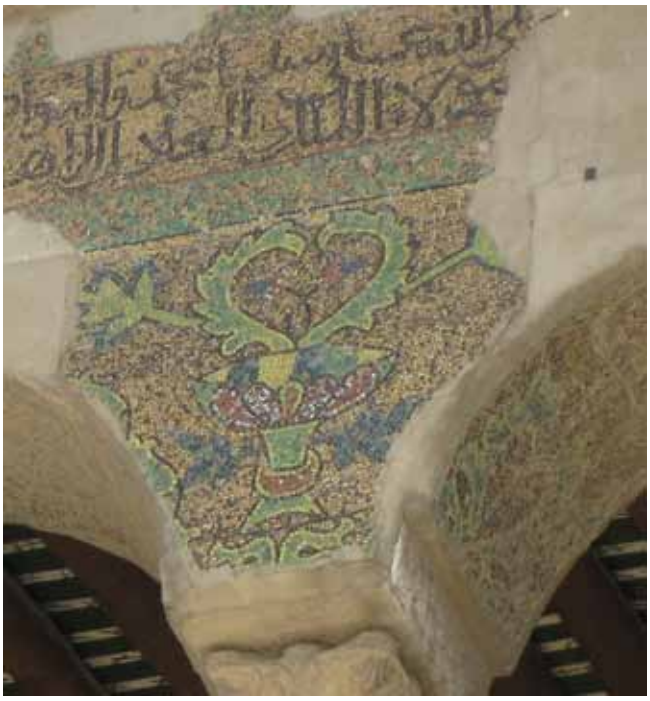


Plate 25 East arcade: detail above column in Plate 23, Great Mosque, Damascus

Plate 26 North arcade: detail of boat, Great Mosque, Damascus

the Egyptian papyriform boats, do not run up onto the prow or stern. However, on the Egyptian examples they run along the top edge or rim of the hull, whereas on the Damascus boat (**Pl. 26**) the dominant lines (red and white) are part-way down the hull – possibly as the result of a misunderstanding. The Damascus boat has a flat bottom but it floats oddly on top of the waves (**Pl. 26**). Immediately above the waves there is a band of brown, yellow and green which results from a misunderstanding of the rendering of the edge of the riverbank in the Landscape Panorama (**Pls 8, 10**). This also suggests that the river was copied from an Umayyad example, like the row of rosettes below it.

Depictions of other boats in Roman and Late Antique mosaics are different to this one. Those in Late Antique church and other floor-mosaics in Syro-Palestine have deeply curved keels on hulls with a curved cross-section. They also lack the deck and cabin of the Egyptian examples. The boats depicted in the wall paintings of the Umayyad bath house of Qusayr 'Amra have the same features as those on these floor mosaics, especially a curved keel. The maritime sailing ships represented in the villa at Lod, *c.* AD 300, have an outward turned prow and stern. Boats in Late Antique Syrian mosaics are sometimes also schematically rendered as a very simple version of them.[74] Gautier-van Berchem noted that the Damascus boat was like those depicted in Pompeian wall paintings, and also compared it to those in the port of Classe in the mosaic in Sant'Apollinaire Nuovo in Ravenna in the 6th century.[75]

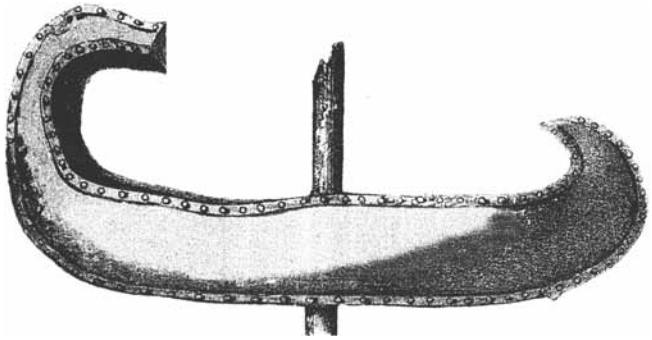


Plate 27 Copper boat from minaret finial, Mosque of Ibn Tulun, Cairo

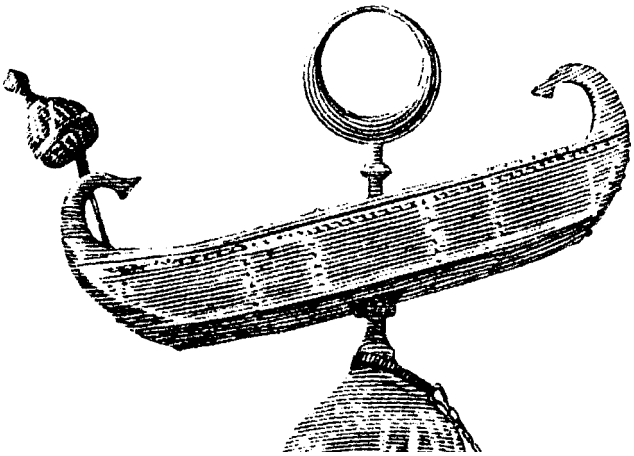


Plate 28 Copper boat on finial of dome, Mausoleum of Imam Shafi'i, Cairo

However, the latter are much closer to the boats depicted in the Late Antique Syrian floors, than to the Egyptian examples.

Two copper boats used as building finials in Cairo are strikingly similar to the Damascus Great Mosque mosaic boat. Both have flat bottoms and their prow and stern are turned inwards. The one on the minaret of Ibn Tulun, mentioned by the Arab historian Maqrizi (1363/4–1442), had a stern that was taller than the prow (**Pl. 27**). This boat survived until the 19th century, having replaced one which came from an ancient Egyptian cache, according to Ibn 'Uthman. The one on the dome of the Mausoleum of Imam Shafi'i has a stern and prow with fishtail-shaped ends (**Pl. 28**).[76] These two boats provide further confirmation of the Egyptian origin of the type of boat represented in the Great Mosque mosaic.

Implications of the Nile boat

If the boat on the north arcade is a Nile boat, and a reflection of such an element in the original Umayyad decorative programme, then it strengthens my previous suggestion of Alexandrian elements in the Landscape Panorama. I also argued there that the reason for depicting architecture alluding to Alexandria was as a way of representing Paradise, and that this had been transferred from the pagan Roman tradition to the Christian and Islamic ones.[77] There is a continuity of meaning as well as form. This did not conflict with representing a paradisal world using elements of the real world. In the Christian tradition the four rivers of Paradise mentioned in Genesis 2.10 include the River Gihon, which Josephus[78] identified as the Nile. On the mosaic floor of the Church of the Holy Martyrs at Tayibat al-Imam, near Hama, made in AD 447, the four rivers are named and represented flowing from Paradise, in which no human figures are depicted, but there are deer and peacocks, as well as trees.[79] By contrast, there are no living creatures in the Great Mosque mosaics, in accordance with Islamic tradition. According to Hadith, the two visible rivers of Paradise are the Nile and the Euphrates.[80] If the designer(s) and workmen were using an Egyptian setting as prototypes scenes to represent Paradise, the Nile boat could have been left in by accident, even if the workmen knew not to depict any figures in it. Equally, it could have been added by later workmen who thought that the river was the Nile.

The written sources indicate that the mosaicists decorated the mosque at Medina (built in AD 707–9) 'according to what were known of the forms of the trees and mansions of Paradise',[81] and that these craftsmen were from Syria and Egypt.[82] It is now generally agreed by Islamicists in their more recent interpretations of the iconography of the mosaics of the Great Mosque in Damascus that they were designed to depict Paradise.[83] Paradise, as described in the Koran, included each of the elements we see depicted in the Landscape Panorama: buildings and fruit trees, with rivers running below. Brisch has demonstrated that the buildings in Paradise are of two types: palaces (monumental architecture, **Pls 7–8**) and 'chambers' (the small plain buildings, **Pls 9–10**).[84] This accounts for the depiction of these two distinctly different types of buildings in the mosaic. The large naturalistic trees are fruit trees (**Pls 7, 9**), as described in the Koran.[85] Rivers are also described as

Plate 29 Detail of 'papyriform' cabin-carrier and papyrus rafts, Nile mosaic, Praeneste (Palestrina)

running below Paradise,[86] which would explain the river at the foot of the panorama. However, the way this river is used also serves to increase the effect of looking into another world because the viewer is looking across the river to the bank opposite him/her (**Pls 7, 9**). The hanging pearls (**Pls 8, 10**), which also allude to Paradise,[87] add to this distancing because they are placed at the entry points to the buildings. These features, the varied proportions of the scenes, the often strange perspective[88] and the total lack of any figures or animals combine to create the effect of an unreal world.

Conclusion

In the Dome of the Rock and the Great Mosque we see two new major buildings in which local classical forms are taken and adapted to make not just new architecture but two buildings which are completely different to each other, in accordance with their different functions and meanings. This is also the case with their mosaics. These are very similar in their use of classical acanthus scrollwork and friezes and naturalistic depictions of large trees. However, it is the additional features that make the decorative programmes of both buildings as distinctively different as the designs of their buildings. On the Dome of the Rock Sasanian elements are introduced: stylized 'lotus' trees and the winged motifs, probably alluding to angels, on the plant candelabra. These stylized trees and wings are absent on the Great Mosque. Architectural features on it, which are probably Alexandrian in origin, are introduced to create the depiction of Paradise, with the river at its base (something which is lacking on the Dome of the Rock). The ability of the artists to create two major new decorative programmes so different from each other, as well as of such high quality and originality, reflects the vitality of early Islamic art, regardless of the origins of its component parts or artists. As Al-Farazdaq observed, 'The inhabitants of Damascus possess in their walls one of the palaces of Paradise, that is to say, the Umayyad Mosque.'[89]

Acknowledgements

This work largely results from my visit, with Oxford University graduate students, to the Great Mosque in April 2010 funded by the Craven Committee of Oxford University. I am especially grateful to George Lewis for taking the additional photographs (**Pls 15, 17–21, 26**) in February 2011, and to Elizabeth Macaulay-Lewis for arranging this. I am also grateful to Ross Burns, Katia Cytryn-Silverman, Jacqueline Dentzer, Zaraza Friedman, Liz James, Konstantin Klein, Priscilla Lange, Sean Leatherbury, Fergus Millar, Elizabeth Montgomerie, Andres Reyes, Nadine Schibille, Luke Treadwell, Alan Walmsley, Helen Whitehouse, Marlena Whiting, the Institut français du Proche-Orient in Damascus and Abboud Khallouf. For reading this paper I am grateful to Elias Khamis, and for additional references, to him, Umberto Bongianino, and especially Jeremy Johns. The photographs in Pls 1, 3–10, 12–13, 16, 22–25, 29, i.e., those by J.S. McKenzie, may be reproduced in academic printed publications, with acknowledgement, without the need to contact her. These and other high resolution images may be found at www.manar-al-athar.ox.ac.uk.

Notes

1 M. Gautier-van Berchem in K.A.C. Creswell, *Early Muslim Architecture*, vol. 1, part 1, Oxford, 1969 (rev. 2nd edn.), 230, 240, 242–5, 321–2, 371. For the most detailed description, discussion and illustrations of the Great Mosque mosaics see ibid., 323–72; for the technique, 364–6, col. pls 35, 53d, 56b, 57b; her interpretation: ibid., 370–2. Brief historical context: R. Hillenbrand, *Islamic Art and Architecture*, Oxford, 1999, 12–16.

2 M. van Lohuizen-Mulder, 'The mosaics in the Great Mosque at Damascus: a vision of beauty', *Bulletin Antieke Beschaving* 70 (1995), 193–213. Aphrodito papyri: references in J. McKenzie, *The Architecture of Alexandria and Egypt 300 BC–AD 700*, London, 2007, 362, 427, nn. 64–5.

3 H. Gibb, 'Arab-relations under the Umayyad Caliphate', *Dumbarton Oaks Papers* 12 (1958), 219–33; O. Grabar, 'Islamic art and Byzantium', *Dumbarton Oaks Papers* 18 (1964), 67–88, esp. 82–3; H. Stern, 'Notes sur les mosaïques du Dôme du Rocher et de la Mosquée de Damas', *Cahiers archéologiques* 22 (1972), 201–32, esp. 223; R. Ettinghausen, *Arab Painting*, New York, 1977, 26, col. pls on 24–5, 27; O. Grabar, *The Dome of the Rock*, Cambridge, MA, 2006, 108. The texts are collected together in E. de Lorey and M. van Berchem, 'Les mosaïques de la Mosquée des Omayyades à Damas', *Monuments et mémoires Fondation E. Piot* 30 (1929), 111–39, esp. 123–39 and Gautier-van Berchem (n. 1), 231–42, where they are evaluated in detail. See also: McKenzie (n. 2), 366–7 who concludes that there is no strong evidence for a major contribution by artisans from Constantinople.

4 F.B. Flood, *The Great Mosque in Damascus*, Leiden, 2001, 12.

5 For the bibliography: McKenzie (n. 2), 427, nn. 40–1; with further examples in G. King, 'The origins and sources of the Umayyad mosaics in the Great Mosque of Damascus', unpublished PhD thesis available online, SOAS, University of London (1976), 237–47, 250–5 (glass wall mosaics and glass tesserae in floor mosaics in Syro-Palestine and Egypt), 255–63 (gold glass in Syro-Palestine).

6 J.E. Quibell, *Excavations at Saqqara (1907–1908)*, Cairo, 1909, 6. On the Main Church at Saqqara: McKenzie (n. 2), 306–11.

7 McKenzie (n. 2), 351–75. The extensive archaeological evidence for Late Antique Egyptian architecture is at 261–321; Hellenistic Alexandrian architecture and its depiction at 80–112.

8 Detailed photographs, description and discussion: Gautier van-Berchem (n. 1), 213–322. The most extensive colour images are in: S. Nuseibeh and O. Grabar, *The Dome of the Rock*, London, 1996. Some examples in Grabar (n. 3), figs 27–32; McKenzie (n. 2), 359–60 (summary), figs 599–604. Reconstruction of exterior mosaics: H.R. Allen, 'Some observations on the original appearance of the Dome of the Rock', in J. Johns (ed.), *Bayt al-Maqdis, Jerusalem and Early Islam* (Oxford Studies in Islamic Art 9.2), Oxford, 1999, 197–213, esp. 208–9, col. pl. on 202–3.

9 McKenzie (n. 2), figs 590, 594, 596–7.

10 For more detail, with references, see: McKenzie (n. 2), 358; also, Grabar (n. 3), 98–107.

11 For the plan: R. Avner *et al.*, 'Jerusalem, Mar Elias, the Kathisma Church', *Hadashot Arkheologiyot, Excavations and Surveys in Israel* 113 (2001), 89*–92* (English) and 133–7 (Hebrew), esp. 134, fig. 199; R. Avner, 'The Dome of the Rock in the light of the development of concentric martyria in Jerusalem: architecture and architectural iconography', *Muqarnas* 27 (2010), 31–49, esp. 38, fig. 6. For a bibliography of archaeological reports: ibid., 45, n. 30. Summary of archaeological evidence: R. Avner, 'The recovery of the Kathisma Church and its influence on octagonal buildings', in G.C. Bottini *et al.* (eds), *One Land – Many Cultures, Archaeological Studies in Honour of S. Loffreda*, Jerusalem, 2003, 173–86, esp. 176–82 (summary of archaeological evidence), figs 4–7 (plans).

12 The inscriptions are largely Koranic quotations as a declaration of faith and how those beliefs differ from Christianity; for references: McKenzie (n. 2), 426, n. 24. Metal plaques: O. Grabar, *The Shape of the Holy, Early Islamic Jerusalem*, Princeton, 1996, 186; A. George, *The Rise of Islamic Calligraphy*, Beirut, 2010, 61, fig. 37. For a summary of theories concerning the function and meaning of the Dome of the Rock, see: Grabar (n. 3), 77–96, 107–19; O. Grabar, *Jerusalem, Constructing the Study of Islamic Art*, IV, Aldershot, 2005, 217–29, esp. 226–9. For a detailed bibliography: McKenzie (n. 2), 426, n. 23.

13 For the plan: R. Ettinghausen, O. Grabar and M. Jenkins-Madina,

Islamic Art and Architecture 650–1250, London, 2001, fig. 13. View: G. Degeorge, *La Grande Mosquée des Omeyyades Damas*, Paris, 2010, pls on 88, 231–2.

14 Pers. comm.

15 P. Gros, *L'Architecture romain du début du IIIe siècle av. J.-C. à la fin du Haut-Empire 1. Les monumens publics*, Paris, 1996, figs 260–1.

16 J.B. Ward-Perkins, *Roman Imperial Architecture*, London, 1981, fig. 186.

17 K.A.C. Creswell, *A Short Account of Early Muslim Architecture*, revised and supplemented by J.W. Allan, London, 1989, 68–9, figs 30, 41.

18 K. Brisch, 'Observations on the iconography of the mosaics of the Great Mosque in Damascus', in P.P. Soucek (ed.), *Content and Context of Visual Arts in the Islamic World*, London, 1988, 13–20, esp. 19, n. 2.

19 Ettinghausen, Grabar and Jenkins-Madina (n. 13), 20, fig. 12. For the development of early mosques see: J. Johns, 'The "House of the Prophet" and the concept of the mosque', in Johns (n. 8), 59–112; proportions: A.G. Walmsley, 'The Umayyad congregational mosque of Jarash in Jordan and its relationship to early mosques', *Antiquity* 79 (2005), 362–78. Tiberias: K. Cytryn-Silverman, 'The Umayyad Mosque of Tiberias', *Muqarnas* 26 (2009), 37–61, esp. 49, fig. 15.

20 E.g., Ettinghausen, Grabar and Jenkins-Madina (n. 13), figs 20, 23, 30.

21 Summary of original decoration: Creswell (n. 17), 55–8. Sultan Baibars' inscription: Gautier-van Berchem (n. 1), 346, fig. 388.

22 See Gautier-van Berchem (n. 1), 324–5.

23 Colour images: Degeorge (n. 13), pls on 7, 81, 84–5, 93, 128, 137, 166–7, 186.

24 Gautier-van Berchem (n. 1), 336–89, figs 392–4, 443, pls 49c, 53a–c, 58c–e; Degeorge (n. 13), pls on 101, 158. The building on the southernmost of the free-standing pillars is a later, pre-20th century repair: Gautier-van Berchem (n. 1), pls 48a, 52d; Degeorge (n. 13), pl. 101 (far right), detail on 171.

25 Detailed discussion of those on the Dome of the Rock and how they differ from later examples in the West: Gautier van-Berchem (n. 1), 252–61. See also Stern (n. 3), 208–12. On the Great Mosque examples: Gautier-van Berchem (n. 1), 333–4, 338, figs 391–6, pls 50d, 51c–d, 58c–e; B. Finster, 'Die Mosaiken der Umayyaden-moschee von Damaskus', *Kunst des Orients* 7 (1970/1), 83–141, esp. 100–10, figs 41–61.

26 Gautier van-Berchem (n. 1), 334–6, figs 395–8, pl. 53d.

27 Detailed description: Gautier van-Berchem (n. 1), 334, 339–46, figs 399–405, pls 54b–58b; Finster (n. 25).

28 Contra, Gautier van-Berchem (n. 1), 368, who considers there is no symmetry in the Landscape Panorama, unlike the wall paintings. The subtle similarities between the mosaics and the wall paintings in the use of symmetry, shadow and shading have not previously been explored.

29 E. de Lorey, 'Les Mosaïques de la Mosquée des Omayyades à Damas', *Syria* 12 (1931), 326–49, esp. 331–4. See also Gautier van-Berchem (n. 1), 367–8; G. Hellenkemper Salies, 'Die Mosaiken der Grossen Moschee von Damaskus', *Corsi di cultura sull'arte ravennate e bizantina* 35 (1988), 295–313, esp. 308–12.

30 Hillenbrand (n. 1), 28; Stern (n. 3), 219.

31 E.R. Knauer, 'Wind towers in Roman wall paintings?', *Metropolitan Museum Journal* 25 (1990), 5–20.

32 McKenzie (n. 2), 93–4, figs 88, 147–8.

33 B. Bergmann *et al.*, 'Roman frescoes from Boscoreale', *The Metropolitan Museum of Art Bulletin* (Spring, 2010), 1–48, esp. 31, figs 55–6.

34 J. Hittorff, 'Pompéi et Pétra', *Revue archéologique* 6 (1862), 1–18. Date of the Khasneh: N.I. Khairy, 'The Mada'in Saleh monuments and the function and date of the Khazneh in Petra', *Palestine Exploration Quarterly* 143 (2011), 167–75, esp. 174.

35 McKenzie (n. 2), fig. 141. See also E. de Lorey, 'L'Hellénisme et l'Orient dans les mosaïques de la Mosquée des Omaiyades', *Ars Islamica* 1 (1934), 22–45, esp. 42.

36 For an updated version of the argument, see McKenzie (n. 2), 80–105. Earlier discussion in J.S. McKenzie, *The Architecture of Petra*, Oxford, 1990, 61–104. References for comments by other scholars on this: McKenzie (n. 2), 391–2, n. 57. It should be remembered that 'main' does not mean 'only'. Also, recent discoveries have shown Roman building activity (and thus influence) in Petra after the annexation of Arabia in AD 106.

37 McKenzie (n. 2), figs 153–4; R. Czerner, *The Architectural Decoration of Marina el-Alamein* (BAR IS 1942), Oxford, 2009, fig. 64.

38 McKenzie (n. 2), fig. 507.

39 Ibid., fig. 460 top right.

40 Detailed discussion: ibid., 351–5, figs 589–92.

41 Syriac, Armenian and Ethiopian: ibid., figs 613–17 (tholoi), 618, 620 (half pediments framing a conch).

42 Ibid., 367–70.

43 Ibid., *cf.* figs 614 and 617.

44 Ibid., 372–5, figs 622–4.

45 L.-A. Hunt, 'Art and colonialism: the mosaics of the Church of the Nativity in Bethlehem (1169) and the problem of 'Crusader' art', *Dumbarton Oaks Papers* 45 (1991), 69–85, esp. 72–3, 75; F.B. Flood, 'Umayyad survivals and Mamluk revivals: Qalawunid architecture and the Great Mosque of Damascus', *Muqarnas* 14 (1997), 57–79, esp. 69–70 argues that the Church of the Nativity mosaics do not provide proof of a continuous tradition of local Muslim expertise. Date: J. Folda, *The Art of the Crusades in the Holy Land 1098–1187*, Cambridge, 1995, 361–4; and especially, J. Folda, *Crusader Art: The Art of the Crusades in the Holy Land, 1099–1291*, Aldershot, 2008, 51, 54.

46 Gautier-van Berchem (n. 1), 348–9. She thought that the east end of the north arcade was Umayyad (at 350); so too King (n. 5), 70.

47 Gautier-van Berchem (n. 1), 350, figs 411–12.

48 I thank George Lewis for additional photographs, on which these observations are based, as I did not have the chance to examine the building again first hand before finishing this paper – I have limited my comments to the mosaics visible in his photographs.

49 Gautier-van Berchem (n. 1), 349.

50 Summary of Seljuq rule in Syria, including the role of Tutush who was governor of Damascus in 1078–95: F.B. Flood, 'A group of re-used Byzantine tables as evidence for Seljuq architectural patronage in Damascus', *Iran* 39 (2001), 145–54, esp. 145, 148.

51 Gautier-van Berchem (n. 1), 349.

52 Ibid., 349; Flood (n. 50), 150. Because the inscription on the east end of the wall refers only to the wall and not the arcades Gautier-van Berchem (at 350) raises the question of whether, if the arcades survived, they could have included some original Umayyad mosaics.

53 Gautier-van Berchem (n. 1), 349, 350–2, fig. 410.

54 Ibid., 352, with references.

55 Ibid., 352.

56 Ibid., 352, fig. 413.

57 Ibid., 352, fig. 415; Degeorge (n. 13), pl. on 173.

58 Gautier-van Berchem does not discuss these, and King (n. 5), 72, assumes that they are Seljuq.

59 E.g., J. Raby, 'Nur al-Din, the Qastal al-Shu'aybiyya, and the "Classical revival" ', *Muqarnas* 21 (2004), 289–310.

60 Gautier-van Berchem also dated these mosaics to Tutush: ibid., 349, 352.

61 Flood (n. 50), 145.

62 Gautier-van Berchem (n. 1), 361–2; Flood (n. 50), 149, fig. 7; Degeorge (n. 13), pl. on 177. Flood (n. 45), 69–70 mentions that the mosaics of the mosque were restored in 1082–3 although arguing that there was not continuity of skill in mosaic making from the Umayyad to the Mamluk period.

63 Gautier-van Berchem (n. 1), 361–2, pl. 62c; Degeorge (n. 13), pl. on 176. No depictions of column capitals survive on it.

64 Gautier-van Berchem (n. 1), 356–60, figs 419–26; Degeorge (n. 13), pl. II on 263.

65 Gautier-van Berchem (n. 1), figs 421–2, 424–5.

66 For a summary of the features of ancient Egyptian boats: C. Ward, 'Ships and shipbuilding', in D.B. Redford (ed.), *Oxford Encyclopaedia of Ancient Egypt*, vol. 3, Oxford, 2001, 281–4, esp. 281–3.

67 H. Whitehouse, *Ancient Mosaics and Wall-Paintings, The Paper Museum of Cassiano dal Pozzo, Series A: Antiquities and Architecture*, Part 1, London, 2001, 72.

68 For a discussion of the boat types in the Praeneste mosaic, see: Z. Friedman, 'The Nile mosaic of Palestrina: an illustration of shipbuilding traditions', *Archaeologia Maritima Mediterranea* 3 (2006), 115–45; Z. Friedman, *Ship Iconography in Mosaics, an Aid to Understanding Ancient Ships and their Construction* (BAR IS 2202), Oxford, 2011, 68–88.

69 E.g. B. Landström, *Ships of the Pharoahs*, London, 1970, 116, figs 276, 358, 361; Ward (n. 66), 283.

70 E.g. Landström (n. 69), fig. 313.

71 Whitehouse (n. 67), 111, no. 12. This boat is discussed in Friedman 2006 (n. 68), 124–6; Friedman 2011 (n. 68), 79–81, 85–7, fig. 3.6.17 (although it is unlikely that the cabin roof was tiled as she suggested on p. 80).

72 Images: Whitehouse (n. 67), 120–1, no. 17; H. Whitehouse, *The Dal Pozzo Copies of the Palestrina Mosaic* (BAR Suppl. Series 12), Oxford, 1976, 22, 62–3, figs 17a–b; Friedman 2011 (n. 68), fig. 3.6.7. I thank Helen Whitehouse for bringing this repair to my notice. Friedman 2006 (n. 68), 120–1, fig. 4; Friedman 2011 (n. 68), 74, fig. 3.6.8 discusses this ship based on the repaired mosaic.

73 Whitehouse (n. 67), 71; Whitehouse 1976 (n. 72), 7.

74 Images of boats in the Levant: E. Grossmann, *Marine Craft in Ancient Mosaics of the Levant* (BAR IS 224), Oxford, 2011. I thank Sean Leatherbury and Marlena Whiting for images of boats on Syrian mosaics, and Jeremy Johns for drawing my attention to the boats at Qusayr 'Amra: C. Vibert-Guigue and G. Bisheh, *Les peintures de Qusayr 'Amra, Un bain omeyyade dans la bâdiya jordanienne*, Beirut, 2007, pls 15c, 16a, 113d and 31. Lod: Friedman 2011 (n. 68), 20–8, figs 3.2.2–6. Simplified examples: Grossmann ibid., figs 23–6.

75 Gautier-van Berchem (n. 1), 350. Followed by Degeorge (n. 13), 170.

76 D. Behrens-Abouseif, *The Minarets of Cairo, Islamic Architecture from the Arab Conquest to the End of the Ottoman Empire*, London, 2010, 55–6, figs 24–5, with references. The purpose of these copper boat finials is not clear, although Behrens-Abouseif suggests that they might be talismanic. I thank Umberto Bongianino for drawing my attention to them.

77 For detailed argument see: McKenzie (n. 2), 112 (in Roman art) and 356, 364–5, 373 (in Christian and Islamic art).

78 Josephus, *Jewish Antiquities* 1. 1. 3.

79 A. Zaqzuq and M. Piccirillo, 'The mosaic floor of the Church of the Holy Martyrs at Tayibat al-Imam – Hamah, in central Syria', *Liber Annuus* 49 (1999), 443–64, esp. 454, plan 1, figs 5, 37.

80 E.g., Salih al-Bukhari Hadith 54. 429. The Nile is also mentioned in 58, 227; 69, 514; 93, 608. The other two rivers of Paradise are invisible.

81 Samhudi (1506) cited in Gautier-van Berchem (n. 1), 238–9; so too Ibn Najjar (1245): King (n. 5), 190. Samhudi also comments that the work of the Copts was the best.

82 McKenzie (n. 2), 366 for analysis with references for sources.

83 Ettinghausen, Grabar and Jenkins-Madina (n. 13), 26; Finster (n. 25), 117–23; Brisch (n. 18); W.B. Denny, 'Reflections of paradise in Islamic art', in S.S. Blair and J.M. Bloom (eds), *Images of Paradise in Islamic Art*, Hanover, NH, 1991, 33–43; Flood (n. 4), 238–9. A notable exception is M. Georgopoulou, 'Geography, cartography and the architecture of power in the mosaics of the Great Mosque in Damascus', in C. Anderson (ed.), *Architecture and the Pictorial Arts from Antiquity to the Enlightenment*, Aldershot, 2002, 47–74. However, the examples from the churches are all walled cities of the real world, usually also specifically identified by labels naming them. For a summary of interpretations of the mosaics by scholars up to 1976: King (n. 5), 180–96. Gautier-van Berchem (n. 1), 370–2, had argued that the Landscape Panorama depicts the Barada River and Damascus. The Jerusalemite al-Muqaddasi in *c.* AD 985 (and later Yaqut and Ibn Shakir) commented: 'There is hardly a tree or a notable town that has not been pictured on these walls', cited by Gautier-van Berchem (n. 1), 233; Ettinghausen (n. 3), 28.

84 Brisch (n. 18), 16–17.

85 Denny (n. 83), 39.

86 Brisch (n. 18), 16, 19, n. 14; Denny (n. 81), 38.

87 Denny (n. 83), 37; Flood (n. 4), 15–56.

88 Brisch (n. 18), 15–16.

89 Cited by Ibn Shakir in M. Quatremère (trans.), *Histoire des Sultans Mamlouks de l'Égypte, écrite en Arabe par Taki-eddin-Ahmed-Makrizi*, vol. 2, part 1, Paris, 1852, 275–6; Flood (n. 4), 34.

Chapter 28
Mosaics by Numbers
Some Preliminary Evidence from the Leverhulme Database

Liz James, Emőke Soproni and Bente Bjørnholt[1]

Mosaic was a widespread form of wall decoration in the Middle Ages. It is found in both the West and the East in greater numbers and in more places than is always realized, and it can be traced in humble as well as elite buildings. The Leverhulme International Network on the composition of Byzantine glass mosaic tesserae raised a variety of questions about the nature and extent of Byzantine wall mosaics. These investigations focused in the first instance on the technical aspects of mosaic making: the relationships between glass making and tesserae making. In the course of this work, it became clear that little was known about the subsequent effect of these issues on the making of actual mosaics. However, that issue could not be explored without a better understanding of the extent of wall mosaic as an art form. It simply is not clear how widely glass wall and vault mosaics were used as an artistic medium in Byzantium or beyond, chronologically and geographically. One of the aims of the Network, therefore, was to begin to fill this hole through a database recording the evidence for wall and vault mosaics, initially in the Byzantine world between the 4th and 15th centuries, but also more widely in the Mediterranean world in that same time period.

Research on wall and vault mosaics tends to focus on individual sites where the mosaics are still *in situ*; wider comparisons are then drawn with other surviving examples.[2] This enables insights into artistic practice (in areas such as style and iconography for example) and dating but does not situate the wall mosaics into a broader context of the extent of wall mosaic as an art form and the questions about artists, materials and manufacture that relate to this. It also means that perceptions of the use of wall mosaics are skewed by the patterns of the survival of such works of art *in situ*. Wall mosaics, because of their location on walls and ceilings, are far more easily destroyed or lost than floor mosaics; indeed, their preservation in many cases appears fortuitous. Such mosaics tend to survive in (usually functioning) churches where they have not been replaced by other forms of art. In Italy, for example, mosaics survive in almost their original state in some churches (as at San Clemente in Rome), but it is also clear that in others, mosaics were renovated, leaving no trace of their medieval appearance (as is the case with some of the mosaics in San Marco, Venice) or they were removed and replaced by other forms of decoration, most notably with fresco (as with the church of San Paolo fuori le Mura in Rome). In the case of Hagia Sophia in Istanbul, the survival of the wall mosaics is unexpected, the result of the actions of a particular sultan, Abdul Medjid.[3] At the Kariye Camii in Istanbul, the covering of the mosaics also ensured their preservation. However, it is more than likely that Christian wall mosaics in other buildings in the city and indeed, more widely in the former Byzantine Empire, were lost over time as the region became Islamic, not only because of the change in religious orientation but also because Islam specifically forbids figural imagery in religious contexts.

As a result of the inevitable focus on surviving works of art, there is a sense of mosaic itself as a relatively scarce medium.[4] Mosaics tend to survive on the walls of buildings in major cities of the empire, and these buildings are ones usually associated with the rich and important, most notably the emperor in Constantinople or Ravenna, the pope in

Figure 1 Map and graph showing new mosaics in the 4th century

Rome and the Norman kings of Sicily. As a result, wall mosaic is perceived as an expensive art, one favoured by the wealthy and important, and employed as a status-symbol. Its use in Italy, most notably in Venice and Palermo in the 12th century, or in places such as Kiev, is interpreted as a sign of acculturation and prestige: important people adopted mosaic as their medium of choice because it gave them a claim to look as if they were Byzantine and all that this might encompass in terms of power and status.[5]

However, a gathering together of extant mosaics suggests that this paradigm might be less than the whole story. Surviving mosaics do not always fit a model of costly, rare and imperial. On Cyprus, three apparently small and insignificant churches, Livadia, Lythrankomi and Kiti, all contained extensive mosaics in their apses, dating between the 6th and 7th centuries. Of these, only the mosaic at Kiti is still in its church, although some of the mosaics from Lythrankomi survive and those at Livadia, now destroyed, have been recorded photographically.[6] In Durrës, Albania, a mosaic is known from a tiny church dated to the 6th to 7th century inside the galleries of the amphitheatre.[7] Although in art-historical terms, the 11th-century mosaics at Daphni are important, the fact that nothing is known about the church, not even to whom it was dedicated and what its original function was, suggests that it was not necessarily an imperial or even a 'significant' foundation.[8]

When finds of mosaic fragments and loose tesserae are factored in to this picture, the possible number of wall and vault mosaics becomes greater and the questions about range and extent of wall mosaic more insistent. For example, in Turkey, fragments of detached glass mosaic and loose glass tesserae have been found at a variety of sites, including

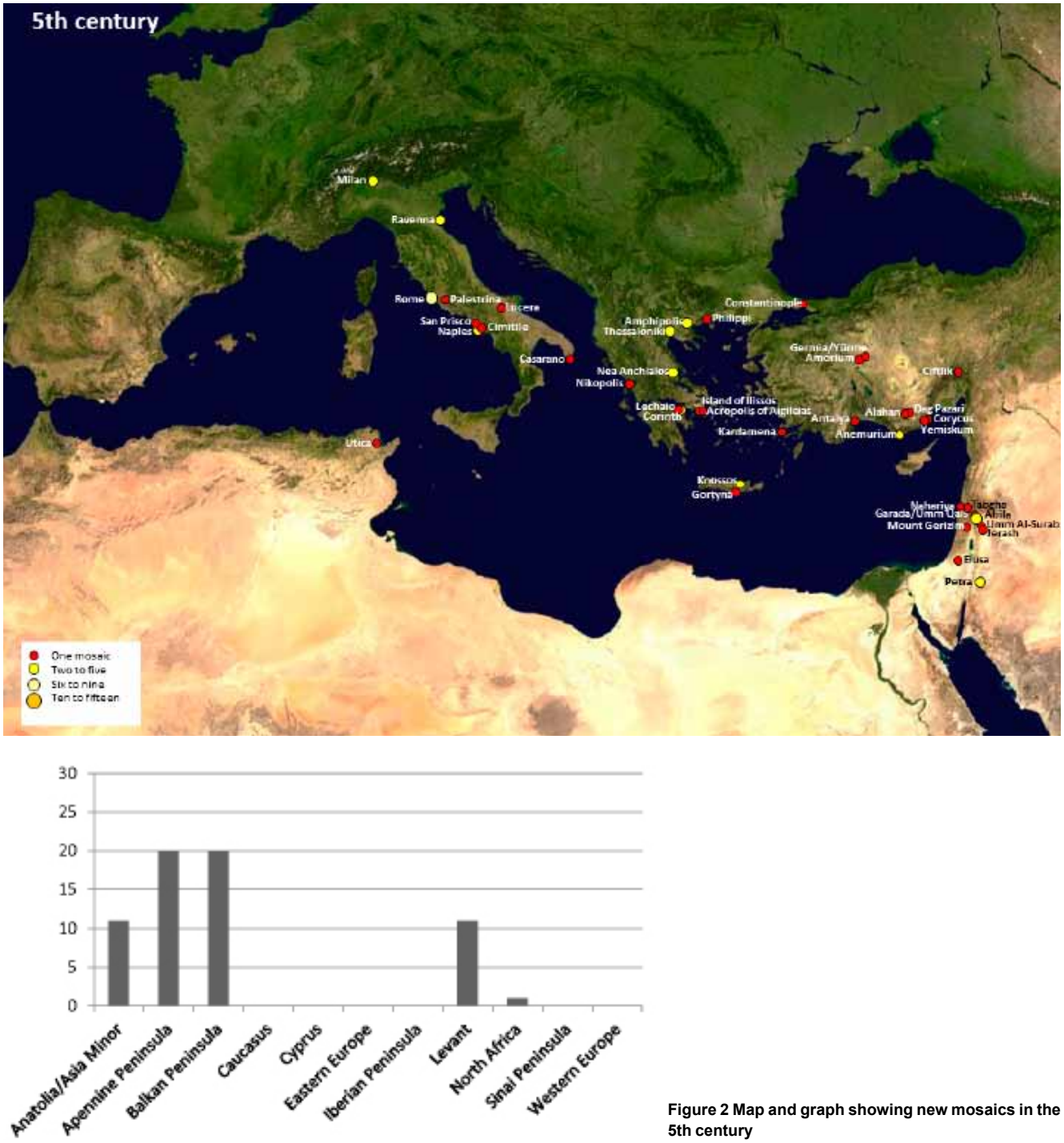


Figure 2 Map and graph showing new mosaics in the 5th century

the Lower City Church in the Anatolian city of Amorium, where they are dated between the 7th and 10th centuries, and in the church of the settlement at Dereağzi in southern Anatolia (late 9th century).[9] Archaeological reports may record the presence of glass tesserae at certain sites and these, especially if stone tesserae are not present in the finds, may well indicate the presence of wall rather than floor mosaics.[10] On the site of the 12th-century church at Kral Kisi, on the western slope of Lake Tasalti, glass tesserae were found scattered on the ground, implying the presence of wall mosaics.[11] In the case of the small church at Çiftlik in Cilicia, Stephen Hill claimed that 'the presence of glass tesserae at both ends of the building suggested that there had been mosaic decoration on vaults throughout the church'.[12] In the Levant, glass tesserae have been found on an extensive range of sites, covering a broad chronology.[13] In Croatia, it has been claimed that in the Early Christian period, 'almost all ruins of palaces, villas, basilicas, baptisteries, mausoleums and baths [...] have traces of wall mosaics'.[14] On Cyprus, Megaw stated that wall mosaic tesserae were found among the remains of 'many' early churches and that many more churches would 'certainly' have been decorated with wall mosaics. He went so far as to suggest that Cyprus could and did support its own mosaic workshops.[15] In Greece, beyond the surviving mosaics at sites such as Hosios Loukas, Daphni, Nea Moni and Arta, evidence for wall mosaics extends to Corinth, Amphipolis, Philippi, Knossos and Athens.[16] In Italy, Irina Andreescu-Treadgold's corpus demonstrates a considerable extent of mosaic decoration over both time and place.[17] Very simply, there is considerably

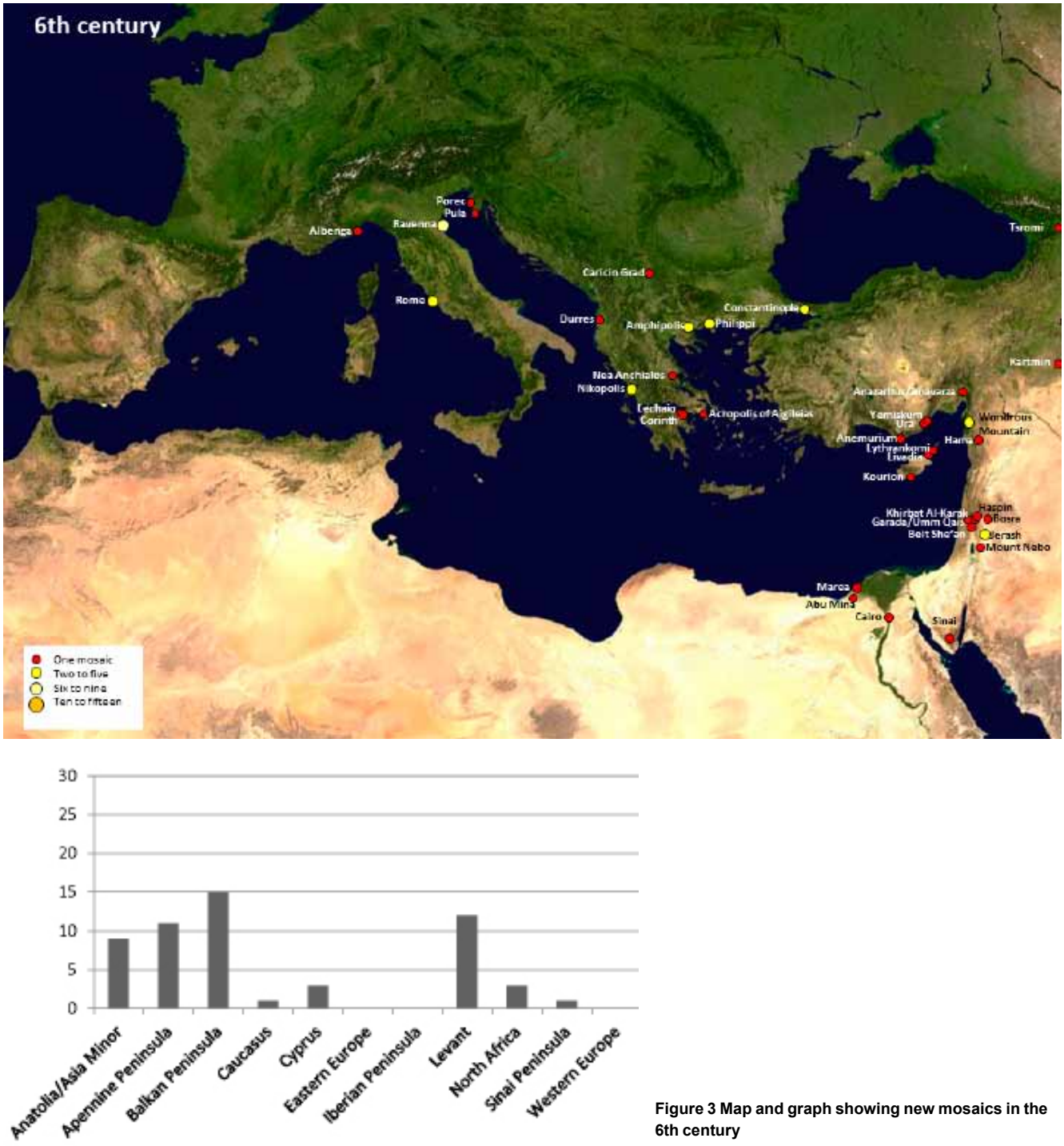


Figure 3 Map and graph showing new mosaics in the 6th century

more additional evidence for wall and vault mosaic than is generally realized.

The Leverhulme database brings together all the material so far gathered in order to document the extent of wall mosaic as a medium. At present (August 2012), the database comprises 292 entries of new mosaics. It is clear that as research continues, more sites will come to light and that consequently, future findings will almost certainly lead us to modify our conclusions and we are certain that some of the current blank areas on the maps will be filled in.[18] Nevertheless, at this point, there is enough of a sample to be able to draw out some preliminary findings and make some tentative suggestions about the distribution of wall mosaics across time and place, as well as to open up debate into some of the assumptions made about the nature of wall mosaics.

In this paper, we have plotted the database entries on maps organized by century, aiming also to give an idea of how many mosaics now survive by region. The final graph in the sequence (**Fig. 13**) locates all the sites together to give an overview of these mosaics. However, it needs to be stressed that the database records new mosaics and that the figures quoted are for additional mosaics. Consequently, our figures, maps and graphs make no reference to losses or rates of attrition and so should not be used to give a sense of the overall number of mosaics in a century. A 6th-century mosaic may well have been still in existence and in view in the 13th century, as with the Justinianic mosaics of Hagia Sophia in Istanbul, for example, but the maps and discussion here do not detail this. As an appendix, we have also listed by name the sites contained on each map; further

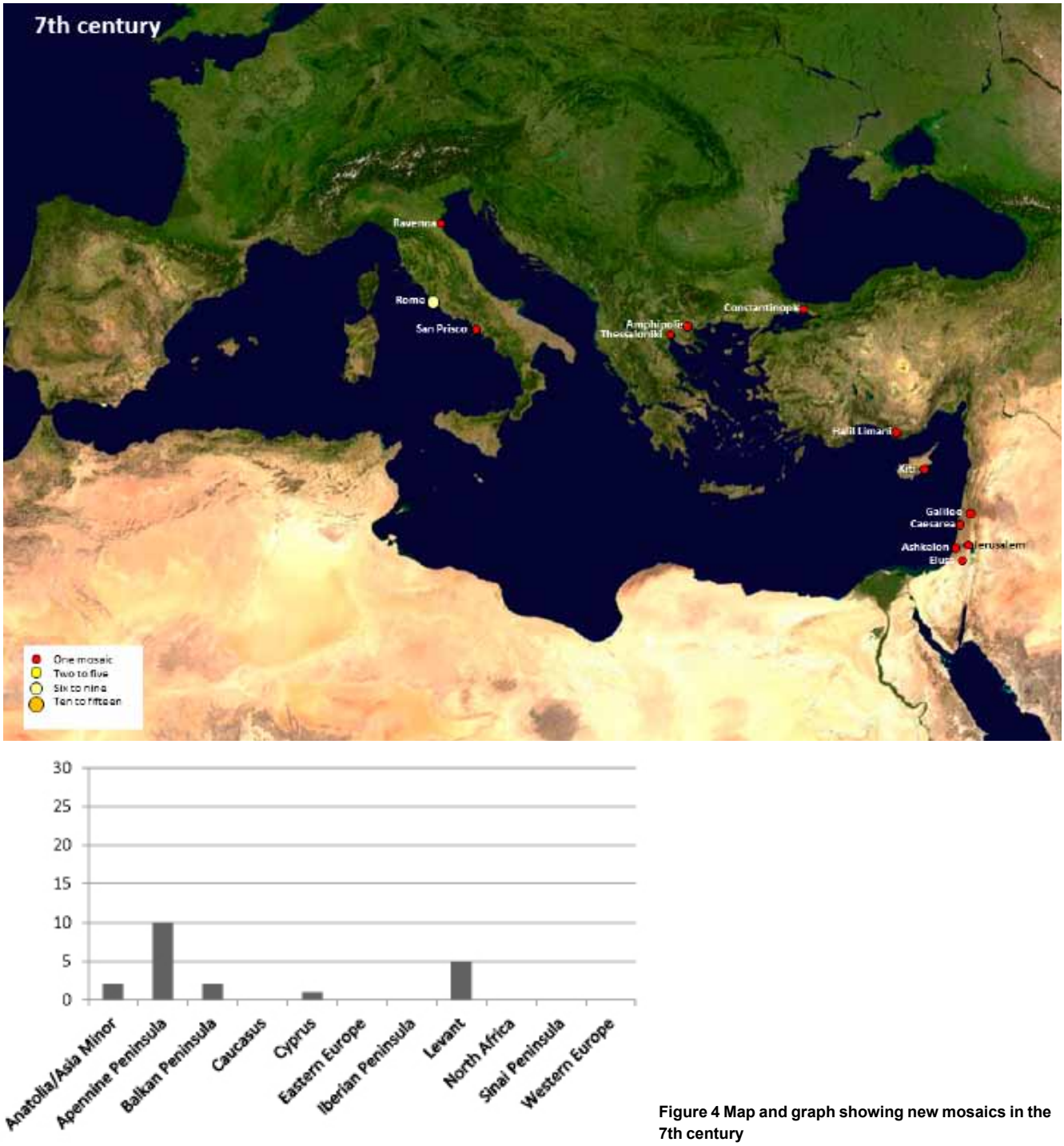


Figure 4 Map and graph showing new mosaics in the 7th century

details of these sites can be obtained from the project database.

The database takes the 4th century as its starting point and records 33 mosaics (**Fig. 1**). The majority are located in Italy, and of the 17 recorded, 12 are from Rome. The eastern provinces of the Roman Empire together contribute almost as many as Italy, but the western provinces register only two, Trier (Germany) and Centcelles, (Spain). Most of the mosaics are in churches and many have funerary contexts. However, several come from 'unknown contexts', which is to say that excavators have not assigned a function to the building in which the mosaics were found or that the tesserae were found as loose scatter at the site.

In the 5th century, 63 new sites are recorded (**Fig. 2**). Again, the majority of surviving examples are from Italy and Rome, but there are more from Greece, Turkey and the Levant (Syria, Jordan and Israel) than before, and noticeably, none are from the western provinces. Almost all examples come from ecclesiastical settings, churches, monasteries and catacombs.

Fifty-five additional mosaics are recorded from the 6th century (**Fig. 3**). Italy contributes 11, of which 6 are from Ravenna and 4 from Rome. Both Greece (11) and the Levant (12) are well-represented. Again, almost all of these sites are ecclesiastical. The 6th-century spread is the widest, bringing in the Balkans as well as Cyprus, Egypt, Georgia and the far east of Turkey.

The weighting of the evidence in the 4th to 5th century period towards Italy and Rome may be fortuitous, representing a region where the chance of survival was

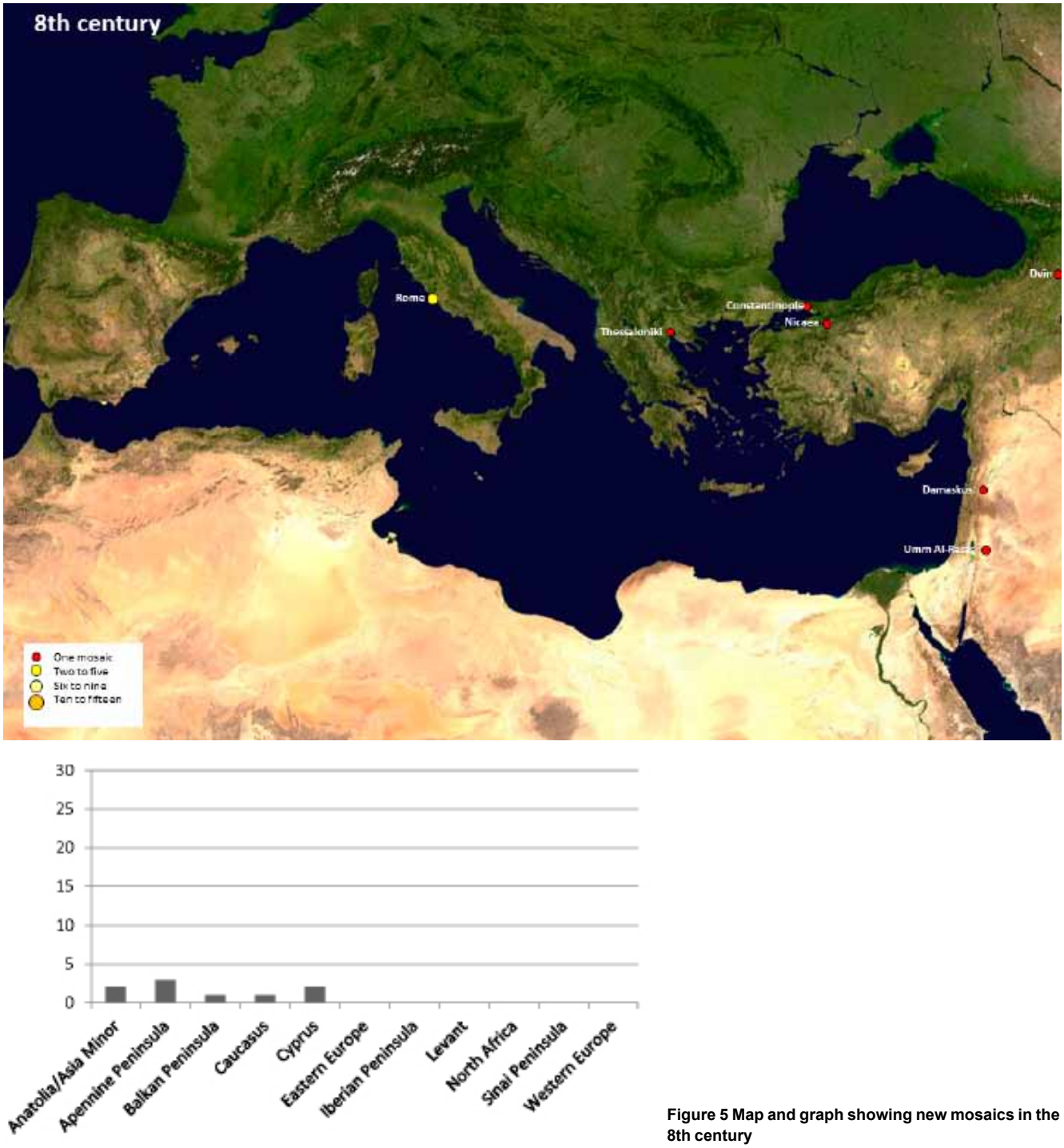


Figure 5 Map and graph showing new mosaics in the 8th century

highest. Nevertheless, their considerable 4th-century presence supports an established contention that wall mosaics were essentially a Roman invention, perhaps dating from the 1st century, and with an increasingly widespread use from Rome outwards.[19] In this Roman context, it is clear that wall mosaics were increasingly used between the 1st and 4th centuries, both for secular and religious commissions and also, as evidence from Pompeii makes clear, across the social scale.[20] Such mosaics became popular in the creation of artificial grottoes and nymphaea, features that were an essential part of a luxury villa. The rise in the quantity of wall and vault mosaics in this period may also have been helped by an increased use of vaulting in Roman architecture, especially in baths, perhaps the result of the more frequent use of concrete. Wall and vault mosaics became an increasingly popular form of decoration among the great imperial builders such as Nero, Domitian and Hadrian and, later in the baths of Caracalla and Diocletian.[21] However, Roman wall mosaics were also employed in religious contexts: by the 2nd century, they are found in Mithraea, where they used the same cave or grotto theme as those in private nymphaea. Mosaic was also used in catacombs in both Rome and Naples.[22] The uses for wall mosaic apparent in the 4th to 6th century echoes this Roman pattern and a considerable emphasis on its use as a medium in the context of religious buildings, both large and small, becomes apparent.

The surviving evidence for the 4th to 6th century implies a use of wall mosaic in major cities, imperial and otherwise, including cities such as Rome, Ravenna, Trier,

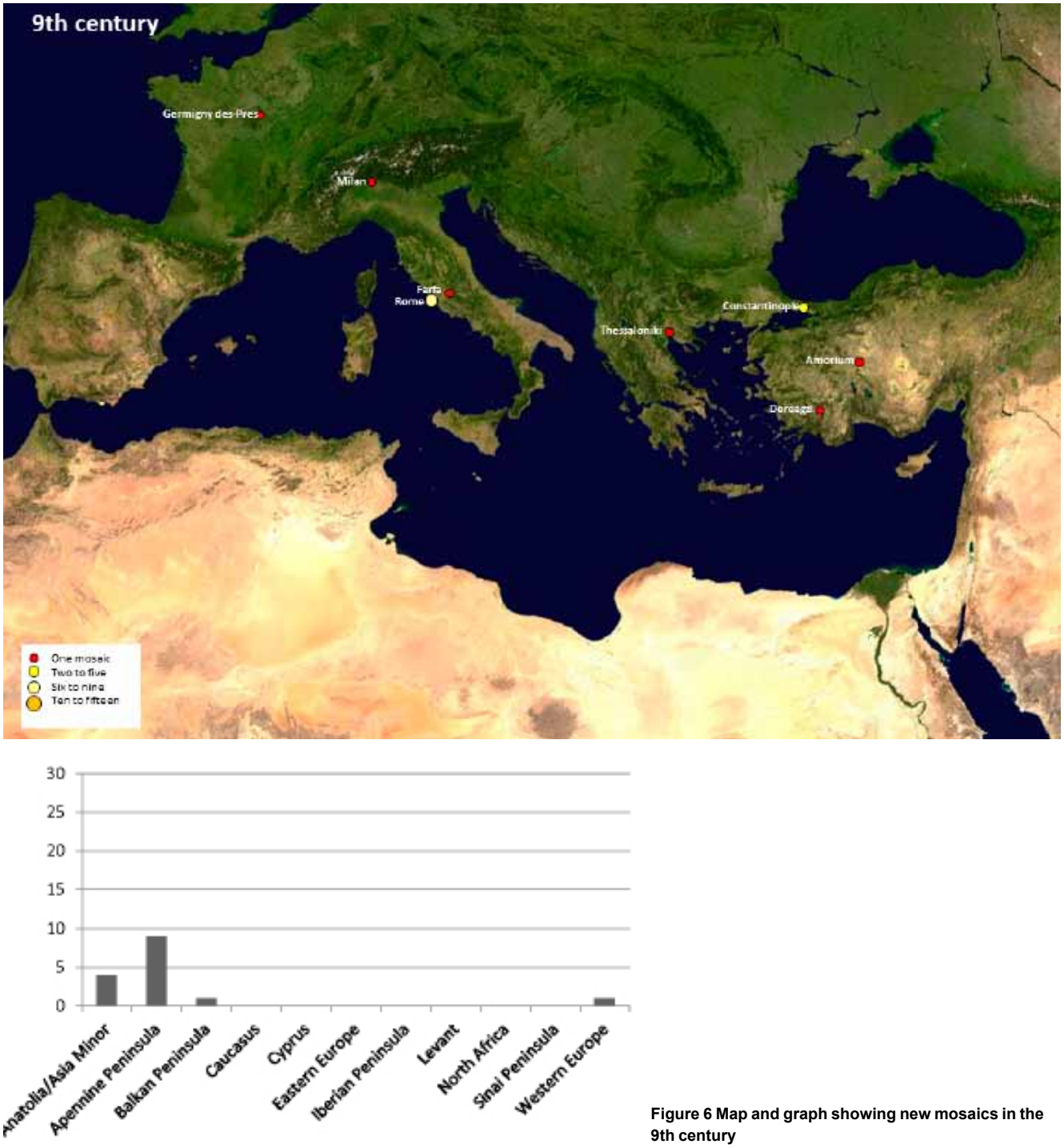


Figure 6 Map and graph showing new mosaics in the 9th century

Constantinople, Thessaloniki and Caesarea. From this, it seems likely that mosaic was also used in other major cities not yet recorded on the database. Our contention here is that if Rome and Constantinople had mosaics, other cities who regarded themselves as important centres – places such as Ephesus and Miletus – would also have used the medium. The presence of glass wall mosaic at smaller sites, such as Çiftlik or the unnamed church at Halil Limanı in Cilicia, and in remoter places such as Tsiromi in Georgia, also supports this possibility, as well as indicating a spread of the medium beyond the big cities. It is hard to believe that there were wall mosaics in Çiftlik but not in Ephesus.

The 5th and 6th centuries appear to have been high points in mosaic manufacture. Numbers of new wall mosaics decrease in the 7th century from figures in the mid-50s to 20 (**Fig. 4**). Nine are Italian sites, eight of which are in Rome. Several churches from the Levant are included, as is the Dome of the Rock mosque in Jerusalem, the first example in the database of an Islamic religious building with mosaic. A further drop in the 8th century is suggested by the surviving material (**Fig. 5**). Here, the number of new mosaics recorded is only nine. Rome again has the majority (three) but again mosaics are found in both churches and mosques in the Levant, and another outlier is apparent, this time in Armenia (Dvin).

The 9th century appears to witness a slight resurgence in mosaic-making (**Fig. 6**). The database records 15 new mosaics in total, seven of which are located in Rome, with one further Italian case, and a unique, remote example from France at Germigny-des-Prés; none are recorded from the

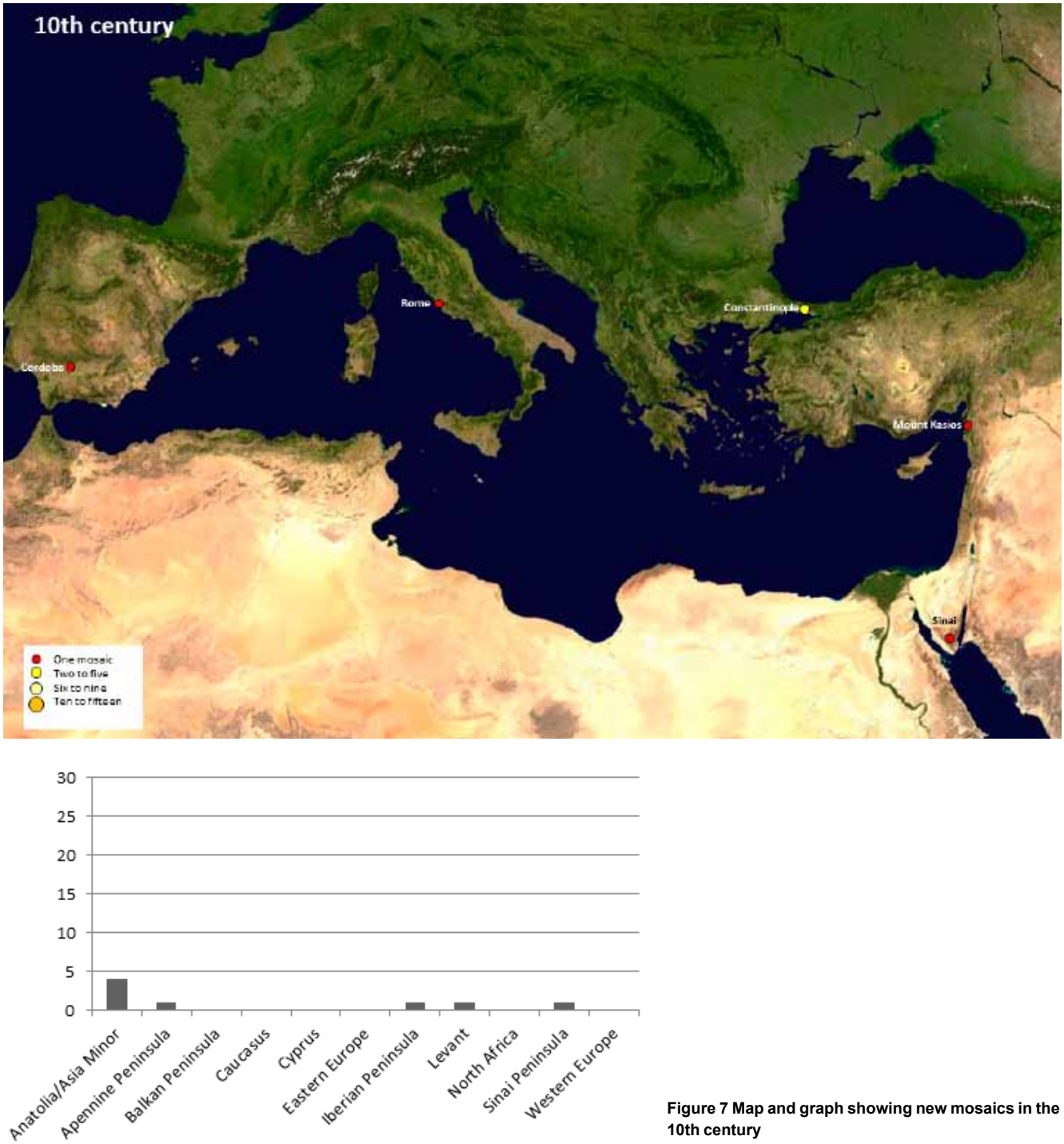


Figure 7 Map and graph showing new mosaics in the 10th century

Levant. Although no 9th-century mosaics, beyond those in Hagia Sophia and Hagia Eirene, survive from Constantinople, written sources provide evidence for at least eight separate churches in the city with new mosaics, all with imperial or aristocratic patronage.[23] There is a slight dip in numbers in the 10th century, where eight additional mosaics are recorded (**Fig. 7**). Three are in Constantinople, one in Rome, and the total includes the Great Mosque in Córdoba. One mosaic site is recorded at the Monastery of St Barlaam on Mount Kasios, near Antioch, suggesting that the medium was again not limited to buildings inside the great cities. There are 16 new sites recorded for the 11th century (**Fig. 8**). Just under half (seven) are in Greece, and include the well-known programmes from Hosios Loukas, Daphni and Nea Moni. There are two examples in Constantinople but, for the first time, none in Rome, though there are three examples from elsewhere in Italy. There is nothing in the Levant. In contrast, Italian mosaics dominate the 12th-century record (**Fig. 9**). Thirty-two in all are noted, of which 20 are in Italy, five in Rome and Sicily alike. There are also examples from the Levant (the Church of the Nativity, Bethlehem and the al-Aqsa mosque, Jerusalem) as well as some more remote places including Aachen, Kiev and Kutaisi (Georgia). Indeed, of the 32 sites, only five come from the Byzantine Empire itself. Twenty-four examples are recorded from the 13th century, 13 in Italy, of which only five are from Rome, three in Constantinople, one in Epiros (Arta) and two in Nicaea (**Fig. 10**). Fifteen examples are recorded for the 14th century, 11 Italian, with Rome dominant, but Pisa, Venice and Florence are among other

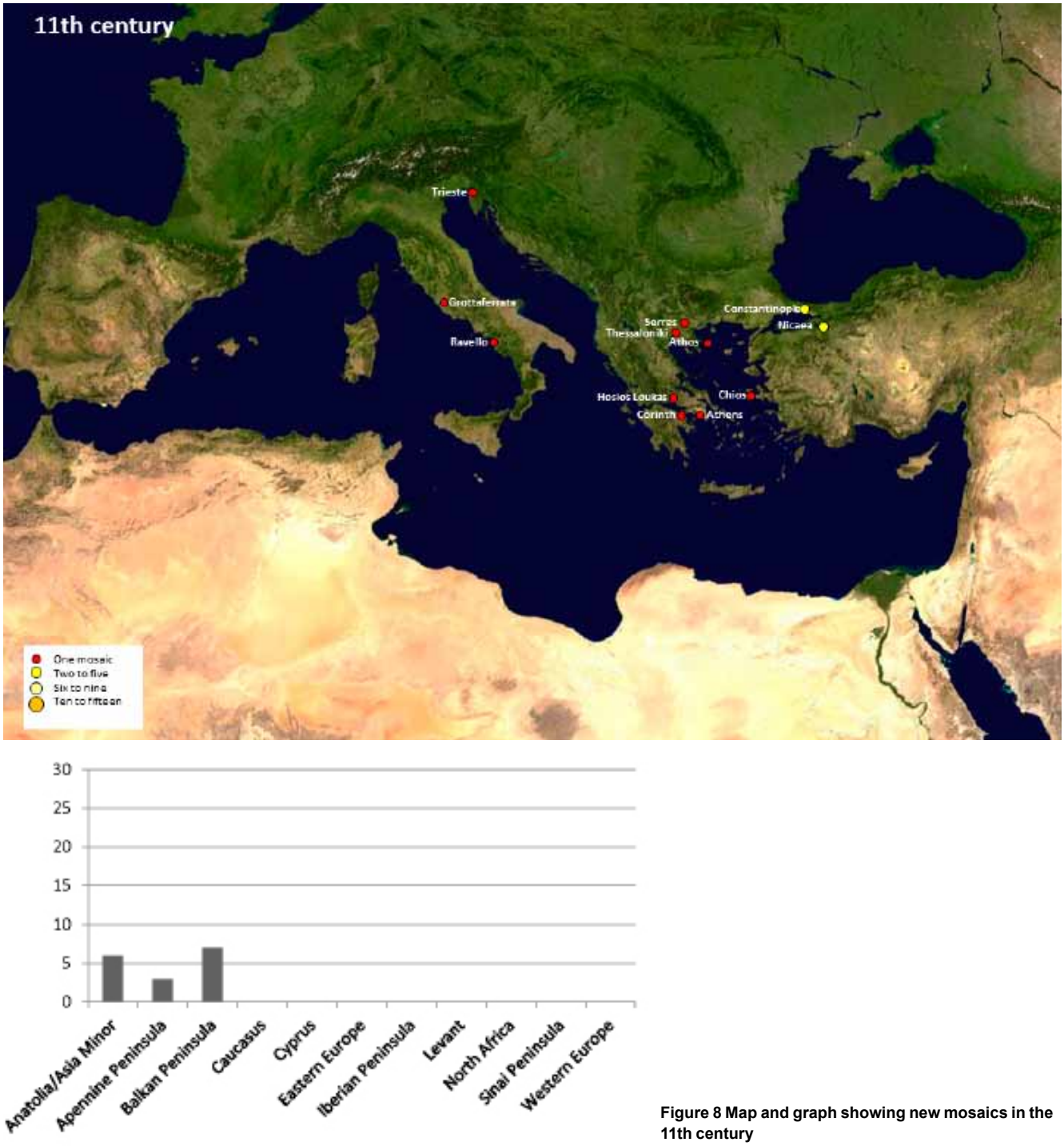


Figure 8 Map and graph showing new mosaics in the 11th century

cities sponsoring wall mosaics (**Fig. 11**). Constantinople has three, Thessaloniki and Athos one each. Finally, two new mosaics are recorded for the 15th century, both Italian; one is in Rome (**Fig. 12**).

Some tentative conclusions can be drawn from these figures and distributions. Major political events may have had an effect on the creation of new work. The spread of mosaics in 6th-century Italy may reflect the Justinianic wars and the increased importance of Ravenna as a Byzantine exarchate. The events of Iconoclasm in the 8th century may have affected the amount of art made in the Byzantine Empire; equally, the Muslim conquests of the 7th century may have played a part in the decrease in religious mosaics in the Levant.[24] The 12th-century resurgence in this area may be a reflection of the Crusader reconquests: most of the new mosaics in the Levant come from Christian centres in Bethlehem and Jerusalem. The spread of mosaics in the 13th century perhaps reflects the existence of the Latin Empire in Constantinople and the rival Byzantine empires based in Epiros (one mosaic), Nicaea (two mosaics) and Trebizond (where mosaics are known but do not survive), followed by the restored empire in 1261 (arguably the Deesis panel in Hagia Sophia).[25]

Local factors may also explain the presence of mosaics at particular locations. The glass wall mosaics in Caričin Grad, Justiniana Prima, in modern day Serbia, in the 6th century, were surely a reflection of that city's foundation by Justinian I, marking out his birthplace. [26] In contrast, although Justinian I and Theodora are depicted in the mosaics of San Vitale in Ravenna, they never went to

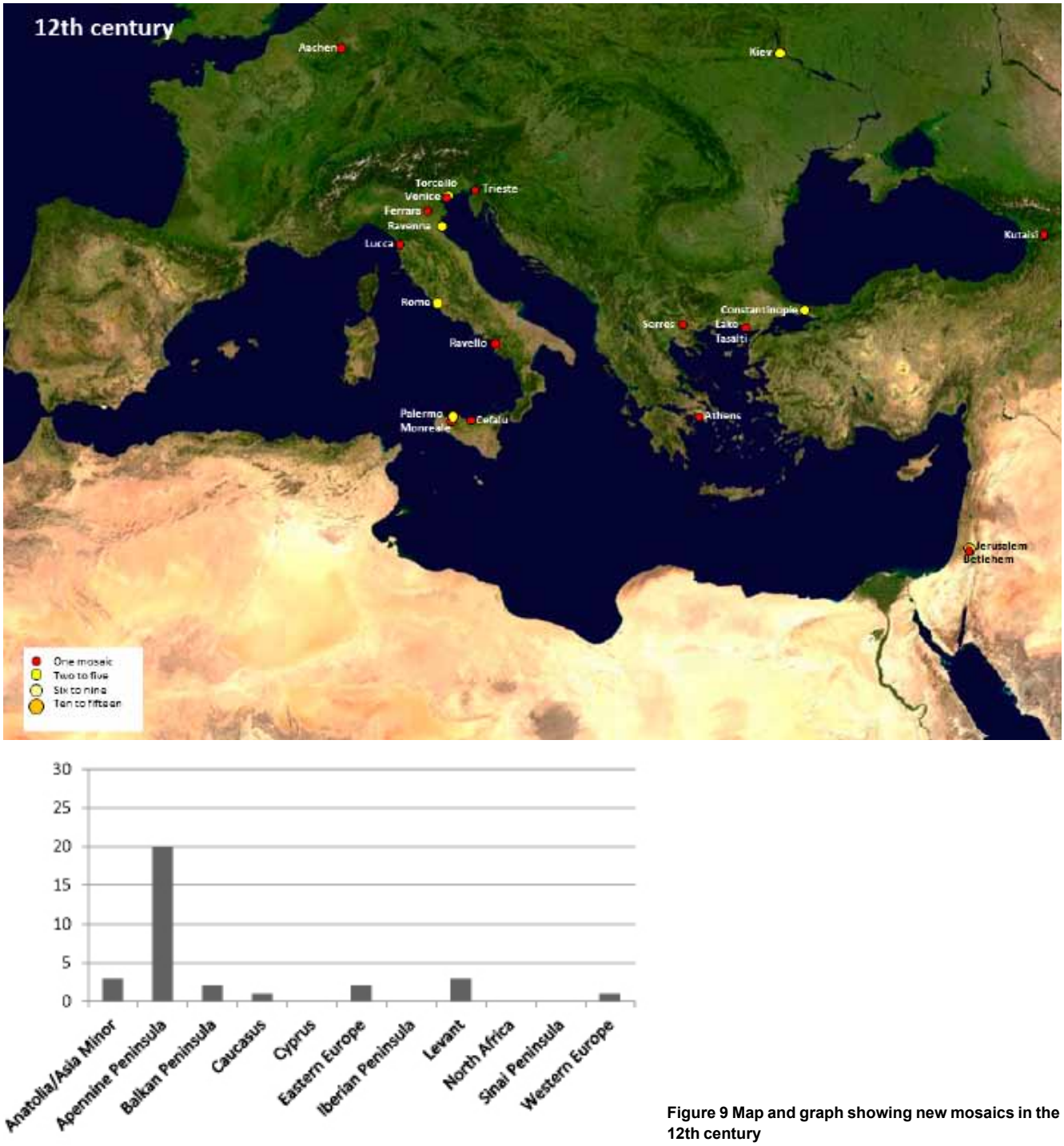


Figure 9 Map and graph showing new mosaics in the 12th century

Ravenna and nothing suggests that they were the patrons of the work. Rather, the mosaics were the project of local notables and must have rebounded to the credit of those men: the banker Julius Argentarius and the city's bishop, Maximian, the latter depicted as a member of the imperial court.[27] The use of mosaic at Germigny-des-Prés in the 8th century, coupled with its unique iconographic programme, appears very much to be the personal decision of the patron of that church, who was Bishop Theodulf, servant of Charlemagne and author of the *Libri Carolini*.[28] Similarly, the patrons of mosaics in Georgia, Rus and Armenia may have had individual reasons, in addition to more general ones about expressing prestige and demonstrating value, for favouring mosaic as their medium of choice. In the 12th and 13th centuries, when mosaics in Italy dominate the maps, it is conceivable that the increase in the number of places with wall mosaics may have been a reflection of local rivalries and competition between major Italian cities rather than simply a response to the Byzantine Empire.

The 10th century is the only time where Constantinople appears as the major centre of mosaic production. In part, this is the result of the vagaries of survival, for written sources make it very clear that there was more mosaic in the city that no longer exists. Nevertheless, the quantity of wall mosaics surviving from Italy across the whole time period of the survey is worthy of comment (see **Fig. 13**). Although this reflects the better chance of survival for the medium in this part of the Mediterranean for a variety of political and religious factors, what the tabulation of the surviving material reveals is the continuous manufacture of new

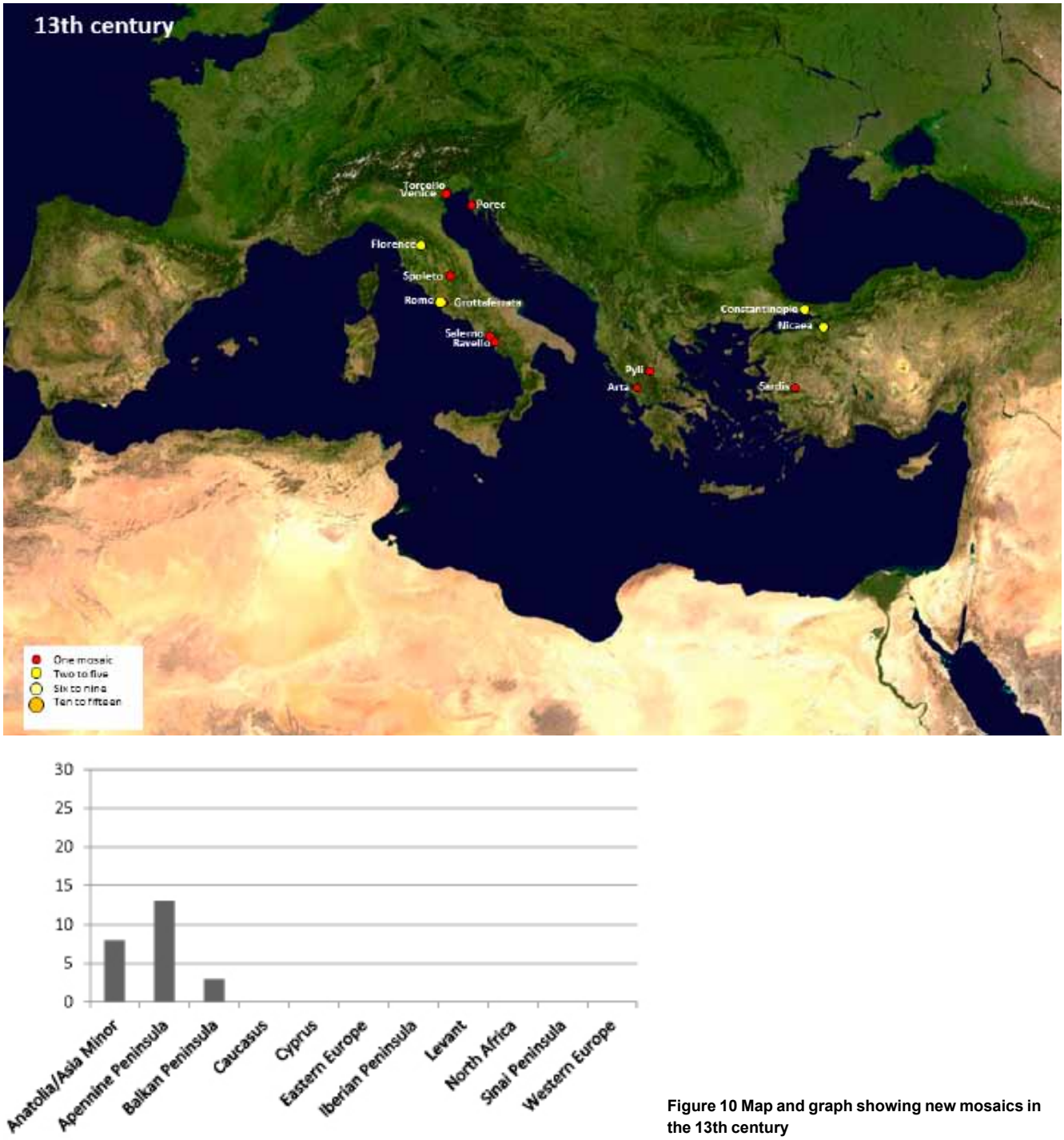


Figure 10 Map and graph showing new mosaics in the 13th century

mosaics in Italy throughout the Middle Ages. Further, it highlights the significance of Rome more specifically as a centre for mosaic, a place for which new mosaics survive from every century but the eleventh.

It is often implied that the mosaics of Italy were made by Byzantine artists but our data raises the question of how far mosaics in Italy should be understood in a setting of regional issues, in particular in the relationship of different cities to Rome, rather than in the context of Constantinople.[29] It is an often-repeated assertion, for example, that Abbot Desiderius at Monte Cassino reintroduced the art of mosaic to Italy in the 11th century. Desiderius' chronicler, Leo of Ostia, recorded that the abbot hired mosaic artists from Constantinople to carry out work on the walls and pavements of the monastery church. Because 'magistra Latinitas' (perhaps 'Italian artists') 'had left uncultivated the practice of these arts for more than five hundred years', Desiderius also had young monks trained up in wall and floor mosaic making.[30] Though Leo's claim of 'five hundred years' has been recognized as a literary trope, nevertheless the concept of a Desiderian reintroduction of mosaic making from Byzantium to a country that had lost the art remains in the scholarly literature.[31] The implications of this have been widespread. Ernst Kitzinger claimed confidently that before the 12th-century apse mosaic of San Clemente, 'no mosaics had been made in Rome for hundreds of years', and that, potentially, the San Clemente mosaic could have been the work of Desiderius' Byzantine workshop.[32] Similarly, Walter Oakeshott proposed that Desiderius' mosaicists went to work in Rome in the revival of mosaics there in the 12th century.[33]

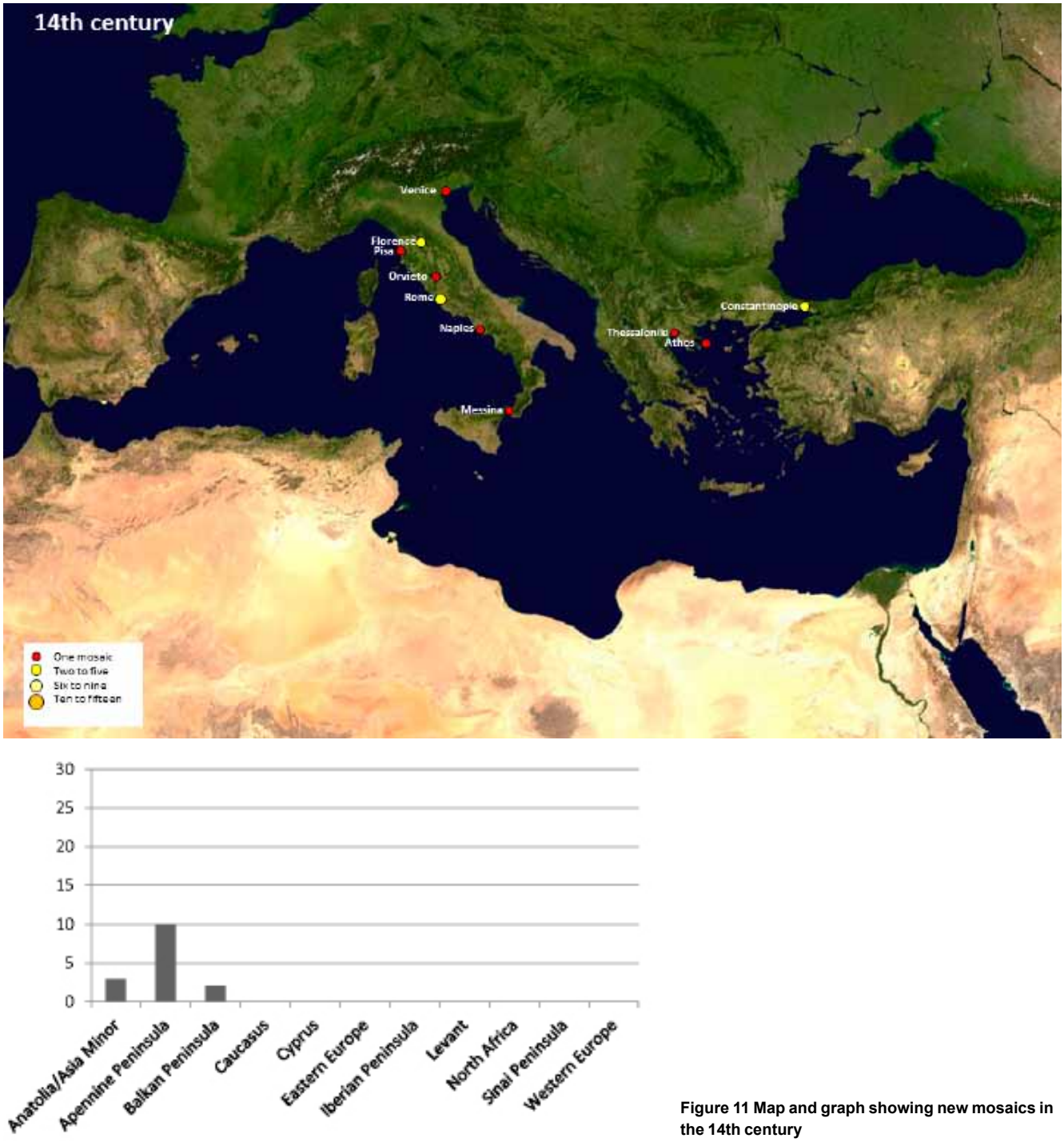


Figure 11 Map and graph showing new mosaics in the 14th century

Whilst Desiderius may very well have imported Byzantine artists to train his local craftsmen, a strong case can be made, in the case of mosaics at least, that this was a matter of choice not necessity. As our figures indicate, the art of mosaic was not lost for 500 years and may never have been lost: mosaics were made in Italy and in Rome throughout the Middle Ages.

A similar assumption is that the 13th-century mosaics of San Marco in Venice owed their creation to an influx of Byzantine artists fleeing Constantinople after the sacking of the city by the Fourth Crusade in 1204 and the establishment of the Latin Empire.[34] Indeed, Otto Demus' belief in the Byzantine nature of the mosaicists of San Marco was fundamental to his dating of the mosaics, since he dated periods of work on the mosaics of the 11th and 12th centuries to times when Veneto-Byzantine relations were favourable, thus enabling Byzantium to supply mosaicists to Venice.[35] However, there is no evidence, beyond arguments based on the perception of artistic style, to support this contention. Claims in the Venetian chronicles that the artists of San Marco were Byzantine are all 16th century or later.[36] Both Desiderius' employment of Byzantine workmen and the Venetian chroniclers' claimed use of Byzantine mosaicists can be seen as calculated decisions in the political, rather than artistic, climate of Italy, perhaps distancing Monte Cassino in the 10th century and Venice in the 16th century from Rome and the use of mosaic in that city.[37]

An awareness of the geographical and temporal extent as well as the distribution of wall mosaics contributes to an understanding of issues around the manufacture of the raw

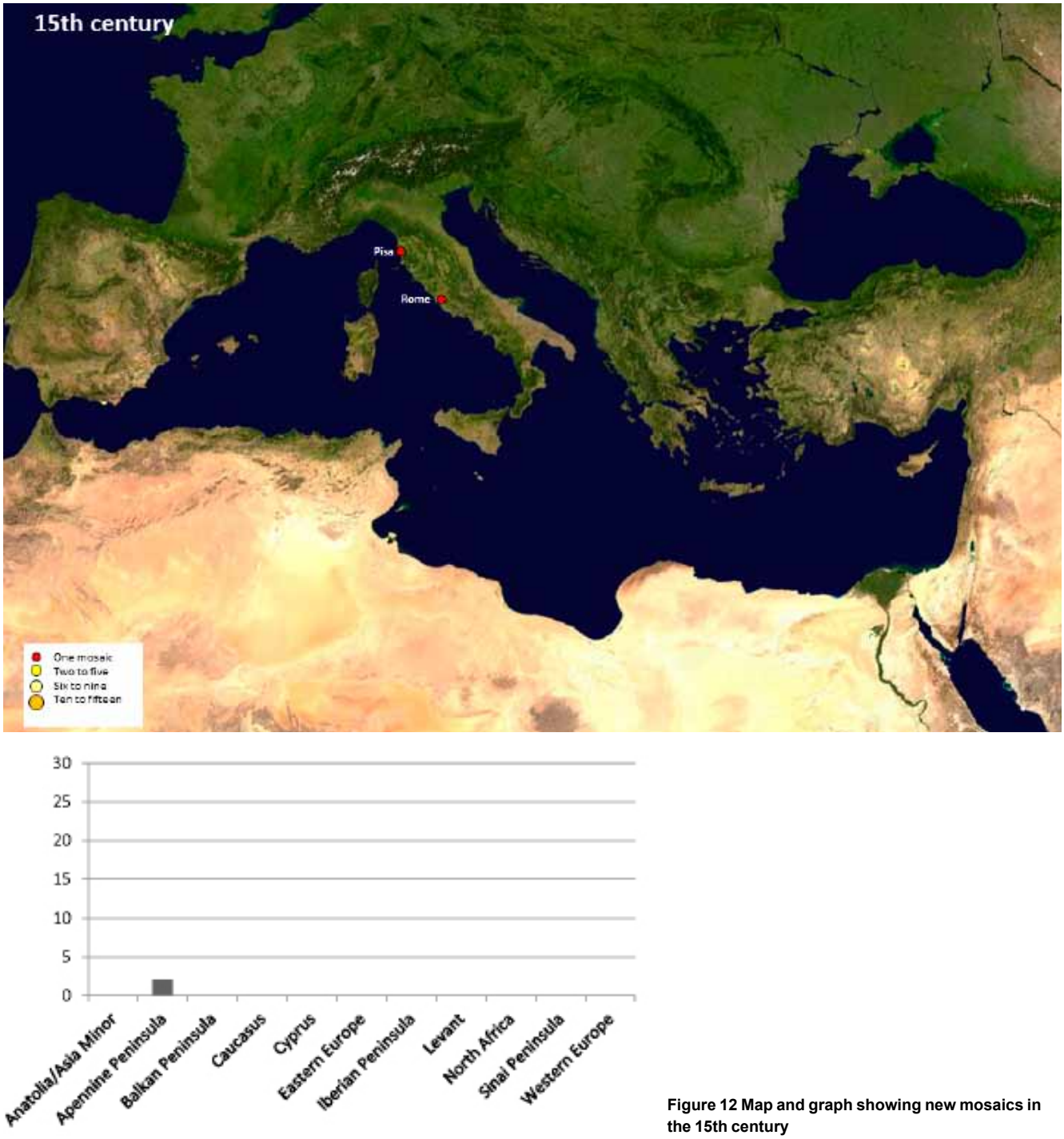


Figure 12 Map and graph showing new mosaics in the 15th century

material of mosaics, glass, and indeed *vice versa*. For example, how did the spread and quantity of wall mosaics in Italy and the eastern Mediterranean in the high points of the 4th to 6th century and the dip in the 7th to 10th century relate to the manufacture and accessibility of raw glass in Italy and the Levant? There is some evidence to suggest that raw glass was made in Italy. Both Strabo, writing in the Augustan period, and Pliny, in the Flavian, mention that glass was produced in Rome during their own times.[38] Recent analytical work has supported Pliny's claim and suggested very strongly that the western Roman Empire had its own raw glass factories.[39] How late this industry continued is unclear but it remains possible that both glass and tesserae could have been produced in Italy for much of the Middle Ages and this would reinforce the potential for a continuous Italian tradition of mosaic-making.[40] In the 4th to 6th century, glass was a relatively cheap medium and raw glass was manufactured in large quantities in the Levant and exported widely around the Mediterranean.[41] However, it is not clear how the 8th-century Muslim conquest of the Levant affected the production and distribution of raw glass, whether it continued to be imported into Byzantium and Italy from the Levant or whether both the Byzantines and different Italian cities themselves began to manufacture glass.[42] We also have no positive sense about where coloured glass was made. Were there to have been a shortfall in glass, especially coloured glass, this would have had a significant effect on the production of mosaics. This situation is possibly reflected in textual sources that record a re-use of tesserae in Constantinople by the 9th-century Byzantine emperor, Basil

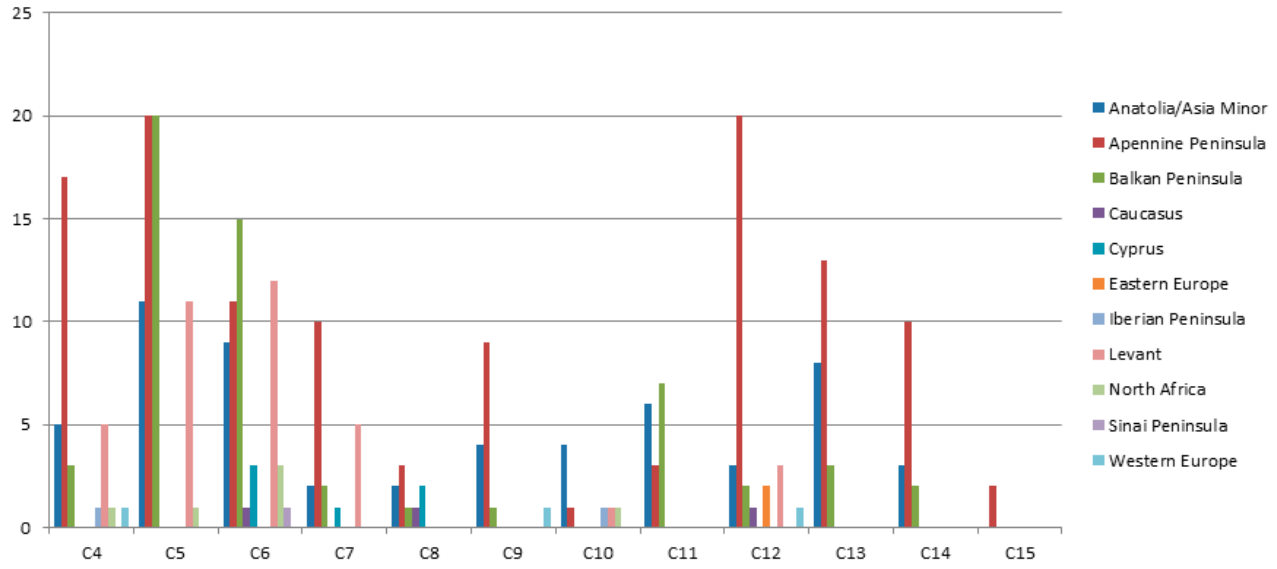


Figure 13 Cumulative graph showing new mosaics by century and region from the 4th–15th century

I.[43] This may well have been a factor in the apparent drop in mosaic manufacture in the 7th to 10th century.

The distribution of mosaics also raises questions about their physical making. To begin with, how did tesserae get to some of these sites, especially to those in more remote locations? The spread of sites is not necessarily linked to geographical features and major trade routes.[44] Although many are coastal sites, some significant ones are not: Amorium in Central Anatolia and Dereağzi in the mountains of Lycia, for example. Over 162kg of glass mosaic tesserae survive from Amorium, calculated to be perhaps 1% of the overall amount required – over 16,000 kilos.[45] Bringing this quantity of either glass or tesserae overland to Amorium would have been no easy feat.[46] At Dereağzi, the quantity of glass seems less and the settlement was linked to Myra by road, though at a distance of some 25km.[47] A further issue relates to mosaic artists and the concept of mosaic 'workshops': on the basis of the numbers of mosaics and their distribution, it seems plausible that there were fixed 'workshops' in big cities but also that mosaicists were itinerant, travelling to where there was work.[48] It seems unlikely, for example, that there was a permanent mosaic workshop in Dvin or Tsiromi, whilst it is highly credible that such workshops could have existed and survived in Constantinople and Rome. However, it also seems improbable that Constantinople was the only home of mosaic workshops. The quantity of mosaic in Italy over an almost unbroken time period suggests strongly that there were several mosaic workshops, at least in Rome.

The quantity of evidence for mosaic that is apparent in this preliminary investigation of sites is surprising. Our sample suggests that mosaics were considerably more widespread throughout the Byzantine Empire than has previously been recognized and that the medium was employed with some consistency over a long period of time (**Fig. 13**). The conventional time frame for mosaic making traces Byzantine wall mosaics from the traditions of Roman wall and pavement mosaics into the 6th and 7th centuries, but documents it as declining in the 7th and 8th centuries and reviving after Iconoclasm in the 9th century on a lesser and more restricted scale, one confined almost exclusively to emperors. However, this survey suggests that this chronology is not as straightforward as has appeared and that a perceived gap in mosaic making in the 7th to 8th century, which is largely based on Constantinopolitan evidence, may not exist as a Mediterranean-wide phenomenon. Indeed written sources make it clear that mosaics, albeit non-religious ones, continued to be made in Constantinople in the 8th century.[49] Additionally, it is unlikely that mosaic-making in Italy, specifically Rome, was affected by Iconoclasm (unless the hypothesis that all mosaicists came from Byzantium is accepted). It is also plausible that the Muslim conquests had a part to play in the spread of mosaic, both in terms of the accessibility of raw glass and in terms of the general use of the medium. In this context, that the bulk of mosaic relates to churches is significant, though it is clear that, especially in the 4th and 5th centuries it was used in secular buildings, including private homes.[50] However, the archaeological evidence also implies a considerable and diverse pattern of patronage, for it is clear that mosaics were used in both rich and poor churches, large and small buildings. All of this material implies that mosaic had a cultural value: it was worth going to the trouble of finding the materials and the makers.

Where then does that leave us? At present, the extent of wall mosaics in the eastern Mediterranean is one needing further investigation, to balance the picture we have of mosaic-making in Italy. As we add to the database, it is hoped that the patterns of mosaic distribution over time and place become clearer, allowing us to develop a better picture of mosaic-making in the Middle Ages.

Appendix 1: Details of sites by centuries taken from the Leverhulme International Network on the Composition of Byzantine Glass tesserae

These are the details of the 292 new mosaics mapped in this paper and are accurate as of 28 August 2012. The database continues to be updated, however.

In the case of sites where the date of the mosaic is uncertain and spread across more than one century, we have plotted the earlier date on the maps.

4th century: 33
Santa Pudenziana, Rome, Lazio, Italy
Old St Peters, Rome, Lazio, Italy
Santa Costanza, Rome, Lazio, Italy
Catacomb of Domitilla, Rome, Lazio, Italy
Santa Maria Assunta, Aquileia, Udine, Italy
Unknown, Caesarea, south of crusader fosse, nr Caesarea, Israel
Building III.5, Anemurium, Cilicia, Anatolia, Turkey
Unknown church, Çiftlik, Cilicia, Anatolia, Turkey
Ashkelon Byzantine church, Barnea district in Ashkelon, south, Israel
Sts Sergios and Bacchos, Umm Al-Surab, Umm Al-Surab, Jordan
Unknown, Thessaloniki, Macedonia, Greece
Basilica D, Amphipolis, Macedonia, Greece
Unknown, Kardamena, Kos, Greece
Mausoleum of Constans I (?), Centcelles, Taragona, Catalonia, Spain
Basilica Ursiana, Ravenna, Emilia-Romagna, Italy
San Giovanni in Laterano, Rome, Lazio, Italy
San Ciriaco, Rome, Lazio, Italy
Unknown, Ostia, Lazio, Italy
Unknown, Halil Limanı, Cilicia, Anatolia, Turkey
Cave church, Meryemlik, Cilicia, Anatolia, Turkey
Town church, Ura, Cilicia, Anatolia, Turkey
BD 31, Garada/Umm Qais, Garada/Umm Qais, Jordan
Lazarus, Bethany, Jerusalem, Israel
Unknown, Palestrina, Palestrina, Italy
Villa Barcaccia, Rome, Lazio, Italy
Catacomb of St Callisto, Rome, Lazio, Italy
Catacomb San Lorenzo, Rome, Lazio, Italy
Catacomb of St Agnese, Rome, Lazio, Italy
Catacomb of St Panfilo, Rome, Lazio, Italy
Catacomb of St Priscilla, Rome, Lazio, Italy
Maison de la Cascade, Utica, Utica, Tunisia
St Peter, Trier, Rhineland-Palatinate, Germany
Mausoleum of Helena, Rome, Lazio, Italy

5th century: 63
Neonian/Orthodox Baptistery, Ravenna, Regio-Emilia, Italy
Capella Arcivescovile, Ravenna, Regio-Emilia, Italy
Mausoleum of Galla Placidia, Ravenna, Regio-Emilia, Italy
St George Rotunda, Thessaloniki, Macedonia, Greece
Hosios David, Thessaloniki, Macedonia, Greece
San Vittore in Ciel d'Oro, Milan, Lombardia, Italy
San Giovanni in Fonte, Naples, Campania, Italy
Santa Maria Maggiore, Rome, Lazio, Italy
San Paolo fuori le Mura, Rome, Lazio, Italy
San Giovanni in Fonte, Rome, Lazio, Italy
Chapel of Sant'Aquilino, Milan, Lombardy, Italy
KMF Basilica, Knossos, Crete, Greece
Acheiropoitos, Thessaloniki, Macedonia, Greece
Petra Church, Petra, Pella, Jordan
Lavreotic Olympus, North of the acropolis of Aigileias, Attica, Greece
Ilissos Basilica, Island of Ilissos, Attica, Greece
Basilica B, Nikopolis, Epirus, Greece
Elusa, Elusa, Negev, Israel
Theotokos Church, Mount Gerizim, West Bank, Israel
Church of the Evangelist, Alahan, Anatolia, Turkey
Unknown, Ciftlik, Cilicia, Anatolia, Turkey
Shavey Zion, Kibbutz Shavey Zion nr Nahariya, Galilee, Israel
Church of the Multiplication of the Loaves and the Fishes, Tabgha, Galilee, Israel
Necropolis Church, Anemurium, Cilicia, Anatolia, Turkey
Lower City Church, Amorium, Cilicia, Anatolia, Turkey
SS Sergios and Bacchos, Umm Al-Surab, Umm Al-Surab, Jordan
Basilica B, Nea Anchialos, Macedonia, Greece
Basilica G, Nea Anchialos, Macedonia, Greece
Octagonal church complex, Philippi, Macedonia, Greece
Basilica A, Amphipolis, Macedonia, Greece
Basilica B, Amphipolis, Macedonia, Greece
Skoutela, Corinth, Corinthia, Greece
Lechaio Basilica, Lechaio, Corinthia, Greece
Kraneion Basilica, Corinth, Corinthia, Greece
Unknown, Kardamena, Kos, Greece
Sanatorium Basilica, Knossos, Crete, Greece
Cumanin Camii, Antalya, Turkey
St John of Stoudios, Constantinople, Marmara, Turkey
Basilica of 'Christ casting out demons from men into pigs', Gadara/Umm Qais, Jordan
Aaron's Monastery, Petra, Jabal Harun, Jordan
Santa Felice, Cimitile, Campania, Italy
Santa Croce, Ravenna, Romagna-Emilia, Italy
Gortyna, Gortyna, Crete, Greece
Chapel of San Cyprian and Santa Justina (or Santa Secunda and Santa Rufina), Rome, Lazio, Italy
Santa Sabina, Rome, Lazio, Italy
St Michael, Germia,Yürme, Galatia, Turkey
San Giusto, Lucera, Puglia, Italy
Transept Church, Corycus, Cilicia, Anatolia, Turkey
Standing Church, Dağ Pazari, Cilicia, Anatolia, Turkey
Central Church, Anemurium, Cilicia, Anatolia, Turkey
Church 1, Yemiskum, Cilicia, Anatolia, Turkey
Unknown, Palestrina, Palestrina, Italy
Catacomb of St Ermes, Rome, Lazio, Italy
Catacomb of St Gaudioso, Naples, Campania, Italy
Catacomb of St Gennaro, Naples, Campania, Italy
Maison de la Cascade, Utica, Tunisia
Basilica A, Nea Anchialos, Macedonia, Greece
Santa Maria della Croce, Casarano, Apulia, Italy
Prophets, Apostles and Martyrs, Jerash/Gerasa, Jordan
Kenchrean Basilica, Corinth, by the Kenchrean Gate, Corinthia, Greece
Area A Basilica, Abila, North, Jordan
Area D Basilica, Abila, North, Jordan
Chapel of St Matrona, San Prisco, Campania, Italy

6th century: 55
Hagia Sophia, Constantinople, Marmara, Turkey
Hagia Eirene, Constantinople, Marmara, Turkey
Arian Baptistery, Ravenna, Regio-Emilia, Italy
Sant'Apollinare Nuovo, Ravenna, Regio-Emilia, Italy

San Vitale, Ravenna, Regio-Emilia, Italy
Sant'Apollinare in Classe, Ravenna, Regio-Emilia, Italy
Eufrasiana, Poreč, Istria, Croatia
Church of the Transfiguration, Sinai, Sinai, Egypt
Sts Cosmas and Damian, Rome, Lazio, Italy
San Lorenzo fuori le Mura, Rome, Lazio, Italy
San Teodoro, Rome, Lazio, Italy
Panagia Kanakaria, Lythrankomi, Cyprus, Greece
Museum Basilica, Philippi, Macedonia, Greece
Lavreotic Olympus, North of the acropolis of Aigileias, Attica, Greece
Basilica A, Nikopolis, Epirus, Greece
Basilica B, Nikopolis, Epirus, Greece
H Georgius, Haspin, Haspin, Israel
Moses, Mount Nebo, Madaba, Jordan
Sts Sergius, Bacchus and Leontius, Bosra, Syria
Unknown, Beit She'an, Jordan Valley, Israel
Building III.5, Anemurium, Cilicia, Anatolia, Turkey
Panagia Kyra, Livadia, Cyprus, Greece
Unknown, Durrës, Durrës, Albania
Anazarbus, Anazarbus/Anavarza, Cilicia, Anatolia, Turkey
Basilica Martyrios, Nea Anchialos, Macedonia, Greece
Octagonal church complex, Philippi, Macedonia, Greece
Basilica C, Amphipolis, Macedonia, Greece
Basilica A, Amphipolis, Macedonia, Greece
Basilica E, Amphipolis, Macedonia, Greece
Skoutela, Corinth, Corinthia, Greece
Lechaio Basilica, Lechaio, Corinthia, Greece
Holy Trinity, Wondrous Mountain, Antioch, Syria
St Martha, Wondrous Mountain, Antioch, Syria
Monastery of St Symeon the Younger Stylite on the Wondrous Mountain, Wondrous Mountain, Antioch, Syria
Unknown, Caričin Grad/Justiniana Prima, southern Serbia, Serbia
San Michele in Africisco, Ravenna, Emilia-Romagna, Italy
St Polyeuktos, Constantinople, Marmara, Turkey
Sts Sergios and Bacchos, Constantinople, Marmara, Turkey
Tomb (Martyr) church, Abu Mina, nr Alexandria, Mariut desert, Egypt
Prophet Jeremias, nr Cairo, Saqqara, Egypt
Prophet Samuel, Simeon, Gabriel, Kartmin, Tur 'Abdin, Turkey
Unknown, Marea, Alexandria, Egypt
St Photios, nr Hama, Apamea, Syria
Town church, Ura, Cilicia, Anatolia, Turkey
Church 1, Yemiskum, Cilicia, Anatolia, Turkey
BD 31, Garada/Umm Qais, Garada/Umm Qais, Jordan
Catacomb of St. Ermes, Rome, Lazio, Italy
Unknown, Kourion, Cyprus, Greece
Tsromi, Tsromi, Khashuri, Georgia
Propylaea, Jerash/Gerasa, North, Jordan
St John the Baptist, Jerash/Gerasa, North, Jordan
San Severo, Ravenna, Reggio-Emilia, Italy
Santa Maria Formosa, Pula, Istria, Croatia
Unknown, Khirbat al-Karak, Galilee, Israel
Unknown, Albenga, Savona, Italy

7th century: 20
Kalenderhane Camii, Constantinople, Marmara, Turkey
St Demetrios, Thessaloniki, Macedonia, Greece
Sant'Apollinare in Classe, Ravenna, Italy
San Pietro in Vincoli, Rome, Lazio, Italy
Santa Agnese, Rome, Lazio, Italy
San Stefano Rotondo, Rome, Lazio, Italy
Santa Costanza, Rome, Lazio, Italy
San Giovanni in Fonte, Rome, Lazio, Italy
San Teodoro, Rome, Lazio, Italy
Chapel of St Venantius, Rome, Lazio, Italy
Panagia Angeloktistos, Kiti, Cyprus, Greece
Dome of the Rock, Jerusalem, Israel
Elusa, Elusa, Negev, Israel
Unknown, Caesarea, south of crusader fosse, nr Caesarea, Israel
Ashkelon Byzantine church, Barnea district in Ashkelon, south, Israel
Basilica D, Amphipolis, Macedonia, Greece
San Ciriaco, Rome, Lazio, Italy
Unknown, Halil Limanı, Cilicia, Anatolia, Turkey
Chapel of S Matrona, San Prisco, Campania, Italy
Khirbet al-Miniya, Galilee, Galilee, Israel

8th century: 9
St Sophia, Thessaloniki, Macedonia, Greece
Hagia Sophia, Constantinople, Marmara, Turkey
San Martino ai Monti, Rome, Lazio, Italy
Santa Maria in Cosmedin, Rome, Lazio, Italy
Triclinium of Giovanni Laterano, Rome, Lazio, Italy
St Gregory, Dvin, Artašat, Armenia
Koimesis, Nicaea, Marmara, Turkey
St Stephen, Umm Al-Rasas, Madaba, Jordan
Great Mosque, Damascus, Syria

9th century: 15
Hagia Eirene, Constantinople, Marmara, Turkey
Hagia Sophia, Constantinople, Marmara, Turkey
St Sophia, Thessaloniki, Macedonia, Greece
San Marco, Rome, Lazio, Italy
Santa Prassede, Rome, Lazio, Italy
San Zeno, Rome, Lazio, Italy
San Martino ai Monti, Rome, Lazio, Italy
Santa Cecilia, Rome, Lazio, Italy
Santa Maria in Domnica, Rome, Lazio, Italy
Santi Nereo e Achilleo, Rome, Lazio, Italy
Lower City Church, Amorium, Cilicia, Anatolia, Turkey
Dereağzi, Dereağzi, Antalya, Turkey
San Ambrogio, Milan, Lombardia, Italy
Theodulf's oratory, Germigny-des-Près, Loiret, Orléans, France
Farfa, Farfa, Lazio, Italy

10th century: 8
Church of the Transfiguration, Sinai, Sinai, Egypt
Barlaam, Mount Kasios (Kaukasos), Antioch, Syria
Hagia Sophia, Constantinople, Marmara, Turkey
Christ Chalkites, Constantinople, Marmara, Turkey
Myrelaion, Constantinople, Marmara, Turkey
Bukoleon Sarayi, Constantinople, Marmara, Turkey
Great Mosque, Córdoba, Andalusia, Spain
San Bartolomeo all'Isola, Rome, Lazio, Italy

11th century: 16
St Sophia, Thessaloniki, Macedonia, Greece
Daphni, Athens, Attica, Greece
Katholikon, Hosios Loukas, Stiris, Greece
Nea Moni, Chios, Chios, Greece
Vatopedi, Athos, Athos, Greece
Santa Maria, Grottaferrata, Lazio, Italy
Hagioi Theodoroi, Serres, Macedonia, Greece
San Giusto, Trieste, Friuli-Venezia Giulia, Italy
Hagia Glykeria, Constantinople, Marmara, Turkey
Nicaea church 1, Nicaea, Marmara, Turkey
Nicaea church 2, Nicaea, Marmara, Turkey
Koimesis, Nicaea, Marmara, Turkey
Hagia Sophia, Constantinople, Marmara, Turkey
Odalar Camii, Constantinople, Marmara, Turkey
Kenchrean Basilica, Corinth, by the Kenchrean gate, Corinthia, Greece
San Giovanni del Toro, Ravello, Campania, Italy

12th century: 32
Cappella Palatina, Palermo, Sicily, Italy
Sant'Apollinare in Classe, Ravenna, Italy
Santa Maria in Monticelli, Rome, Lazio, Italy
Santa Maria in Trastevere, Rome, Lazio, Italy
San Clemente, Rome, Lazio, Italy
Santa Francesca Romana, Rome, Lazio, Italy
La Zisa, Palermo, Sicily, Italy
La Martorana, Palermo, Sicily, Italy
Palazzo dei Normanni, Palermo, Sicily, Italy
Santa Maria la Nuova, Monreale, Sicily, Italy
Santissimo Salvatore, Cefalù, Sicily, Italy
San Marco, Venice, Veneto, Italy
Santa Maria Assunta, Torcello, Veneto, Italy
Santi Maria e Donato, Torcello, Veneto, Italy
Church of Nativity, Bethlehem, Bethlehem, Israel
al-Aqsa mosque, Jerusalem, Jerusalem, Israel
Hagioi Theodoroi, Serres, Macedonia, Greece
Theotokos Parthenos, Athens, Attica, Greece
Gelati Monastery, nr Kutaisi, Imereti, Georgia
St Sophia, Kiev, Ukraine
St Michael, Kiev, Ukraine
San Giusto, Trieste, Friuli-Venezia Giulia, Italy
Kral Kizi, on the western slope of Lake Tasalti, Marmara, Turkey
Hagia Sophia, Constantinople, Marmara, Turkey
San Frediano, Lucca, Tuscany, Italy
San Crisogono, Rome, Lazio, Italy
San Giorgio, Ferrara, Emilia-Romagna, Italy
Ursiana, Ravenna, Emilia-Romagna, Italy
San Panteleone, Ravello, Amalfi, Italy
Palatine chapel, Aachen, North Rhine-Westphalia, Germany
Holy Sepulchre, Jerusalem, Jerusalem, Israel
Pantocrator, Constantinople, Marmara, Turkey

13th century: 24
Eufrasiana, Poreč, Istria, Croatia
Santa Maria in Aracoeli, Rome, Lazio, Italy
Santa Maria Maggiore, Rome, Lazio, Italy
Santa Maria in Trastevere, Rome, Lazio, Italy
Santi Maria e Donato, Torcello, Veneto, Italy
Santa Maria Assunta, Spoleto, Umbria, Italy
Santa Maria, Grottaferrata, Lazio, Italy
San Giovanni, Florence, Tuscany, Italy
San Matteo, Salerno, Campania, Italy
San Marco, Venice, Veneto, Italy
Kalenderhane Camii, Constantinople, Marmara, Turkey
Hagia Sophia, Constantinople, Marmara, Turkey
Church E, Sardis, Manisa, Turkey
Panagia Parigoritissa, Arta, Epirus, Greece
Nicaea church 1, Nicaea, Marmara, Turkey
Nicaea church 2, Nicaea, Marmara, Turkey
Theotokos Panagiotissa/Theotokos Panagia Mougliotissa, Constantinople, Marmara, Turkey
San Tommaso in Formis, Rome, Lazio, Italy
St John Prodromos, Constantinople, Marmara, Turkey
Myrelaion, Constantinople, Marmara, Turkey
San Panteleone, Ravello, Amalfi, Italy
San Bartolomeo all'Isola, Rome, Lazio, Italy
San Miniato, Florence, Tuscany, Italy
Porta Panagia, Pyli, Thessaly, Greece

14th century: 15
Santa Maria Assunta, Pisa, Tuscany, Italy
Old St Peters, Rome, Lazio, Italy
Santa Maria in Cosmedin, Rome, Lazio, Italy
San Paolo fuori le Mura, Rome, Lazio, Italy
San Marco, Venice, Veneto, Italy
Santa Maria, Orvieto, Orvieto, Italy
Holy Apostles, Thessaloniki, Macedonia, Greece
Vatopedi, Athos, Athos, Greece
San Giovanni, Florence, Tuscany, Italy
Theotokos Pammakaristos, Constantinople, Marmara, Turkey
Holy Saviour in Chora, Constantinople, Marmara, Turkey
Vefa Kilise Camii, Constantinople, Marmara, Turkey
Chapel of Maria del Principio, Naples, Campania, Italy
Santa Maria Assunta, Messina, Sicily, Italy
San Miniato, Florence, Tuscany, Italy

15th century: 2
Santa Maria Assunta, Pisa, Tuscany, Italy
Chapel of St Helen, Rome, Lazio, Italy

Notes

1 The database was the work of Bente Bjørnholt, the Network Facilitator, with the assistance of the University of Sussex Web team. Emőke Soproni was responsible for the maps, graphs and tables. The database is available at http://www.sussex.ac.uk/byzantine/mosiac.

2 For an outstanding example, see A. Terry and H. Maguire, *Dynamic Splendor: The Wall Mosaics in the Cathedral of Eufrasius at Poreč*, 2 vols, University Park, Pennsylvania, 2007.

3 N.B. Teteriatnikov, *Mosaics of Hagia Sophia, Istanbul: The Fossati Restoration and the Work of the Byzantine Institute*, Washington DC, 1998.

4 Something of this was discussed in L. James, 'Byzantine glass mosaic tesserae: some material considerations', *Byzantine and Modern Greek Studies* 30 (2006), 29–48.

5 For the use of mosaic in this context, see E. Borsook, *Messages in Mosaic. The Royal Programmes of Norman Sicily 1130–1187*, Woodbridge, 1998; reprint of Oxford 1990.

6 Livadia: A.H.S. Megaw and E.J.W. Hawkins, 'A fragmentary mosaic of the Orant Virgin in Cyprus', *Actes du XIV Congrès International des études byzantins*, Bucharest, 1972 (1976), vol. 3, 363–6; Lythrankomi: A.H.S. Megaw and E.J.W. Hawkins, *The Church of the Panagia Kanakaria at Lythrankomi in Cyprus*, Washington DC, 1977; Kiti: A.H.S. Megaw, 'Early Byzantine monuments in Cyprus in the light of recent discoveries', *Akten der XI Internationalen Byzantinistenkongress*, Munich, 1958 (1960), 345–51.

7 N. Thierry, 'Une mosaique à Dyrrachium', *Cahiers Archéologique* 18 (1968), 227–9, who suggests that the mosaic may be dated to the 8th century; K. Bowes and J. Mitchell, 'The main chapel of the Durres amphitheatre. Decoration and chronology', *Melanges d'archéologie et d'histoire de l'école française de Rome, Antiquité*, 121 (2009), 571–97, who argue for a possible 11th-century dating.

8 R. Cormack, 'Rediscovering the Christ Pantokrator at Daphni', *Journal of the Warburg and Courtauld Institutes* 71 (2008), 55–74.

9 Amorium: J. Witte-Orr, 'Fresco and mosaic fragments from the Lower City Church', in C.S. Lightfoot (ed.), *Amorium Reports II: Research Papers and Technical Reports*, Oxford, 2003, 139–58; Dereağzi: J. Morganstern, *The Byzantine Church at Dereağzı and its Decoration*, Tübingen, 1983.

10 Floor mosaics tend to contain relatively little glass, with glass tesserae used to highlight specific features. Colours are likely to be those in the blue-green range, occasionally red and very occasionally gold. In the database, we have taken the presence of glass tesserae in several colours as a rule of thumb indicating the presence of wall mosaic rather than floor mosaic, particularly when coupled with an absence or a lack of stone tesserae.

11 S. Başaran, 'Ortacagda enez Ainos', *Sanat Tarihi Dergisi* (1. Ortacag ve Turk Donemi Kazilari Sempozyumu, 9–11 April 1997), Izmir, 1998, vol. 9, 1–12, esp. 10.

12 S. Hill, 'The first season of rescue excavations at Çiftlik (Sinop)', *Journal of Anatolian Studies* 45 (1995), 219–32.

13 See James (n. 4), 30–3.

14 By M. Buzov, 'Early Christian mosaics on the Adriatic coast', *Acta XIII Congressus Internationalis Archaeologiae Christianae*, Split, 1998, vol. 3, 175–86.

15 A.H.S. Megaw, 'Byzantine architecture and decoration in Cyprus: metropolitan or provincial?', *Dumbarton Oaks Papers* 28 (1974), 74; also A.H.S. Megaw, 'Interior decoration in early Christian Cyprus', *Acts of 15th International Byzantine Congress*, Athens, 1976, 3–29.

16 Corinth: R. Scranton, R.J.W. Shaw and L. Ibrahim, *Kenchreai, Eastern Port of Corinth* 1, *Topography and Architecture*, Leiden, 1978, 105; J.M. Shelley, 'The Christian basilica at the Cenchrean Gate at Corinth', *Hesperia* 12 (1943), 166–89; Amphipolis: K. Hattersley-Smith, *Byzantine Public Architecture between the Fourth and Eleventh Centuries AD, with Special Reference to the Towns of Byzantine Macedonia*, Thessaloniki, 1996, 106; Philippi: E. Kourkoutidou-Nikolaidou, 'Vitraux paléochrétiens à Philippes', *Corso di Cultura sull'Arte Ravennate e Bizantine* 31 (1984), 277–96; Knossos: R.J. Sweetman, 'Late Antique Knossos. Understanding the city: evidence of mosaics and religious architecture', *The Annual of the British School at Athens* 99 (2004), 333–5; Athens: N. Chatzidakis, 'Mosaics and wall-paintings in Byzantine and Postbyzantine churches in Athens', in K. Staikos, C. Bouras, S. Sakellariou and E. Touloupa (eds), *Athens: From the Classical Period to the Present Day (5th century B.C.–A.D. 2000)*, Athens, 2003, 246–79.

17 For example, I. Andreescu-Treadgold, 'Les mosaiques de la lagune venetienne aux environs de 1100', *Acts of 15th International Byzantine Congress*, Athens, 1976, 15–30 and *eadem*, 'A corpus of wall-mosaics, Venice, Greece, St Sophia: progress and prospects', *Byzantine Studies Congress Abstracts* 5 (1979), 51–2.

18 It should also be noted that this database does not include buildings that no longer survive unless the mosaics do survive elsewhere: that information is being put on a second database of written sources. We welcome all additions, emendations and contributions: please email either E.James@sussex.ac.uk or B.K.Bjornholt@sussex.ac.uk.

19 F.B. Sear, *Roman Wall and Vault Mosaics*, Heidelberg, 1977; K.M.D. Dunbabin, *Mosaics of the Greek and Roman World*, Cambridge, 1999; also, L. James, 'Successors of Rome? Byzantine glass mosaics', in J. Bayley and J. Price (eds), *Successors of Rome*, forthcoming.

20 F.B. Sear, 'The earliest wall mosaics in Italy', *Papers of the British School at Rome* 43 (1975), 83–97; Sear (n. 19); H. Lavagne, *Operosa Antra. Recherches sur la grotte à Rome de Sylla à Hadrien*, Rome, 1988.

21 See Sear (n. 19); Lavagne (n. 20); J. DeLaine, *The Baths of Caracalla: A Study in the Design, Construction, and Economics of Large-Scale Building Projects in Imperial Rome*, Portsmouth, Rhode Island, 1987.

22 Sear (n. 19), cat. nos 112–18 (mithraea); 152–62 (catacombs).

23 The eight are Photios's 10th Homily on the Pharos Church, Leo VI's Sermons 28 (about the Kauleas church) and 34 (the church of Stylianus Zaoutzes), the *Vita Basilii's* account of the Church of the Holy Apostles, the Kainourgion, the Church of the Prophet Elijah and the Nea Ekklesia, and the anonymous *De sacris aedibus Deiparae ad Fontem* (about the Kataphyge). Photios: *Homilies*, B. Laourdas (ed.), *Photiou Homiliai*, Thessaloniki, 1959; Leo VI: *Homilies*, T. Antonopoulou (ed.), *Leonis VI Sapientis Imperatoris Byzantini Homiliae*, Turnhout, 2008; *Vita Basilii*: *Chronographiae Quae Theophanis Continuati Nomine Fertur Liber Quo Vita Basilii Imperatoris Amplectitur*, I. Ševčenko (ed. and trans.), Berlin, 2011; *De sacris aedibus*, in *Acta Sanctorum*, November III, 882.

24 Although see: L. Brubaker and J. Haldon, *Byzantium in the Iconoclast Era c. 680–850: A History*, Cambridge, 2011, for a reappraisal of Iconoclasm.

25 See A.A.M. Bryer and D. Winfield, *The Byzantine Monuments and Topography of the Pontos*, Washington DC, 1985, vol. 1, 239 (the Chrysokephalos).

26 J. Drauschke, 'Early Byzantine glass from Caričin Grad / Justiniana Prima (Serbia): first results concerning the composition of raw glass chunks', in B. Zorn and A. Hilgner (eds), *Glass along the Silk Road from 200 BC to AD 1000*, Mainz, 2010, 53–71.

27 D.M. Deliyannis, *Ravenna in Late Antiquity*, Cambridge, 2010.

28 A. Freeman and P. Meyvaert, 'The meaning of Theodulf's apse mosaic at Germigny-des-Prés', *Gesta* 40/2 (2001), 125–39.

29 L. James, 'Mosaic matters. Questions of manufacturing and mosaicists in the mosaics of San Marco, Venice', in H. Maguire and R.S. Nelson (eds), *San Marco, Byzantium and the Myths of Venice*, Washington DC, 2010, 227–43.

30 Leo of Ostia, *The Chronicle of Monte Cassino* 3, 27: 'Et quoniam artium [ie wall and pavement mosaic] istarum ingenium a quingentis et ultra iam annis magistra Latinitas intermiserat.' Text and translation from H. Bloch, 'Monte Cassino, Byzantium and the West in the Earlier Middle Ages', *Dumbarton Oaks Papers* 3 (1946), 198 and n. 110.

31 For 500 years as a trope, see Bloch (n. 30), n. 110. On Byzantine art in southern Italy, see H. Belting, 'Byzantine art among Greeks and Latins in Southern Italy', *Dumbarton Oaks Papers* 28 (1974), 1–29.

32 E. Kitzinger, 'The Gregorian reform and the visual arts: a problem of method', *Transactions of the Royal Historical Society* 22 (1972), 93, 94, 99.

33 W. Oakeshott, *The Mosaics of Rome*, New York, 1967, 243.

34 O. Demus, *The Mosaics of San Marco in Venice*, Chicago and London, 1984, vol. 2, 215–18.

35 Demus (n. 34), vol. 1, 3–4 and 291–2, and vol. 2, 216; O. Demus, *The Church of San Marco in Venice: History, Architecture, Sculpture*, Washington DC, 1960, 26.

36 James (n. 29), 236–7.

37 Ibid., 238–43.

38 Strabo, 16.2.25; Pliny, *Natural History* 36.194; also see, J. Price, 'Glass-working and glassworkers in towns and cities', in A. MacMahon and J. Price (eds), *Roman Working Lives and Urban Living*, Oxford, 2005, 167–90, esp. 169.

39 P. Degryse and J. Schneider, 'Pliny the Elder and Sr-Nd isotopes: tracing the provenance of raw materials for Roman glass production', *Journal of Archaeological Sciences* 35 (2008), 1993–2000.

40 See A. Silvestri, G. Molin and G. Salviulo, 'Roman and medieval glass from the Italian area: bulk characterization and relationships with production technologies', *Archaeometry* 47 (2005), 797–816; D. Stiaffini, *Il Vetro nel medioevo*, Rome, 1999; M. Mendera, 'Produzione vitrea medievale in Italia e fabbricazione di tesserae musive', in E. Borsook, F. Giofreddi Superbi and G. Pagliarulo (eds), *Medieval Mosaics: Light, Colour, Materials*, Milan, 2000, 97–138; M. Ferri, 'Reperti vitrei altomedievali dagli scavi di Torcello e San Francesco del Deserto – Venezia', *Journal of Glass Studies* 48 (2006), 173–89; also James (n. 29).

41 James (n. 4).

42 N. Schibille, 'Late Byzantine mineral soda high alumina glasses

from Asia Minor: a new primary glass production group', *PLoS ONE* 6 (2011), e18970 for evidence of primary glass production in post-8th-century Byzantine Asia Minor.

43 The re-use of tesserae by Basil I is seen as evidence for a drop in production by A. Cutler, 'The industries of art', in A. Laiou (ed.), *The Economic History of Byzantium*, vol. 2, Washington DC, 2002, 560.

44 On issues around the ease of transport and trade, see M. McCormick, *Origins of the European Economy*, Cambridge, 2001, and P. Spufford, *Power and Profit. The Merchant in Medieval Europe*, London, 2002, esp. chs. 4 and 5.

45 C. Lightfoot and E. Ivison, 'Concluding remarks', in M.A.V. Gill, *Amorium Reports, Finds 1, the Glass (1987–1997)*, Oxford, 2002, citing A.C. Cutler, 'Mosaic', in A. Kazhdan *et al.* (ed.), *The Oxford Dictionary of Byzantium*, vol. 2, New York, 1991, 1412–13. Witte-Orr (n. 9), 143, says that the 23,000 or more tesserae recovered perhaps made up 1% of the total required.

46 Lightfoot and Ivison (n. 45), 259–64, though they feel it plausible that everyday glassware would be of local manufacture.

47 See the points made in J. Morganstern and R.E. Stone, 'The church at Dereağzi: a preliminary report on the mosaics of the diaconicon', *Dumbarton Oaks Papers* 23/24 (1969/70), 391.

48 This issue has been keenly debated in the context of floor mosaics: L.-A. Hunt, 'The Byzantine mosaics of Jordan in context: remarks on imagery, donors and mosaicists', *Palestine Exploration Quarterly* 126 (1994), 106–26; Dunbabin (n. 19), 269–78; D. Zohar, 'Mosaic artists in the Byzantine east: towards a new definition of workshop construction', *Early Christian Art* 3 (2006), 143–52; K.C. Britt, 'These stones still speak: the progress of research on late Roman and early Byzantine mosaic pavements in the Eastern Mediterranean', *Journal of Art Historiography* 5 (2011), 1–41.

49 For example, Constantine V's non-figural mosaics in the Blachernae church: *Life* of St Stephen the Younger, ch. 29: M.-F. Auzépy (ed. and trans.), *La Vie d'Etienne le Jeune par Etienne le Diacre*, Aldershot, 1997, 126–7 (text) and 221–2 (translation).

50 For example, F. Krinzinger, *Das Hanghaus 2 in Ephesos. Die Wohneinheiten 1 und 2. Baubefund, Ausstattung, Funde* (Forschungen in Ephesos 8/8), Vienna, 2010.

Chapter 29
Early Islamic and Byzantine Silver Stain

Lisa Pilosi and David Whitehouse†

Introduction

This paper describes the use of silver stain from its beginnings in the Islamic world to its supposed discovery or re-discovery in the early 14th century by glass painters in France. Despite a great deal of scholarly interest in silver stain, there are still many unanswered questions about the origin and transfer of this technology. Evidence for the use of silver stain on glass objects made in the Byzantine Empire and adjacent regions in and after the 9th century is presented as a possible explanation for the continuity or transmission of the technique between the Islamic or Byzantine worlds and 14th-century France.

Before presenting this history, it is important to clarify what is meant by 'stain'. The chemistry of the staining process is essentially the same whether it is applied to ceramic glazes to produce so-called lustre ware, or to glass vessels or flat panels to produce stained glass. A stain or lustre depends on the formation, just below the surface of a glass, of a film of metallic nanoparticles (which are particles between 1 and 100 nanometres in size, a nanometre being one billionth of a metre).[1] It is distinct from other types of colouration caused by the precipitation of metallic nanoparticles from the glass melt – such as in ruby or dichroic glasses. In the latter, colouration is achieved by adding a minute quantity of copper, gold, or a gold-silver alloy to the glass melt which form nanoparticles on cooling and subsequent heat treatment, known as 'striking'. The particles, which are distributed evenly throughout the glass, create colouristic effects by the scattering of light. In ruby glasses, copper or gold particles create a deep transparent red, while in dichroic glasses, particles of a gold-silver alloy cause the glass to be one colour in reflected light and another colour when light shines through it.[2]

By contrast, stain is produced by the application to the surface of a glass of a metallic compound (generally containing silver or copper or a combination of the two), in a carrier, such as clay or ochre, with a sulphur-containing compound.[3] When this paste is dry, it is fired in a reducing atmosphere at a moderate temperature, below the softening point of the glass, to avoid deformation. During the firing, the applied compound is chemically reduced to metallic nanoparticles, which migrate into the body of the glass. After cooling, the residue of the paste is wiped off to reveal a permanent stain beneath the surface.

Stains can range in colour from whitish to greenish or lemon yellow to deep reddish orange or ruby red, and occasionally they have a metallic reflectance. They can be transparent, translucent, or opaque, even-toned or mottled. Their appearance seems to be influenced in part by the composition of the base glass, the composition of the stain, and by the temperature and duration of firing, which affects the final size and density of the metallic particles.[4] The diffusion of the metallic particles is somewhat irregular so that a few are deposited outside the edges of the intended design, creating faint 'halos'. Because all the metallic particles are formed within the glass, the surface remains flat after the application of stain, whereas enamel is fused on the surface of glass and can be felt with the tip of a finger. Although stains can be produced using silver or copper or a

Plate 1 Drinking horn, 8th–9th century, l. 21.5cm. The Corning Museum of Glass, Corning, New York (69.1.4)

Plate 2 Cup, 8th century, h. 10cm. The Corning Museum of Glass, Corning, New York (69.1.1)

combination of both, for the purposes of this paper the term 'silver stain' will apply to all types of stain.

Silver stain in the Islamic world

Chronology

Despite the degree of interest in silver stain, its origin remains obscure. Seventy years ago, the great scholar of Islamic glass, Carl Johan Lamm, maintained that the earliest silver-stained glass objects were made in Egypt, 'probably as early as the 4th century'.[5] A similar view was expressed by Stefano Carboni in his 2001 catalogue of the al-Sabah collection. Silver staining, he maintained, 'was in all probability "invented" by Coptic glassmakers in Egypt in the 6th or 7th century'.[6] Elsewhere, he has compared the ornament on a silver-stained drinking horn in The Corning Museum of Glass (**Pl. 1**) to the mosaics representing vases filled with flowers and leaves in the late 7th-century Dome of the Rock.[7]

Until recently the bowl of a goblet excavated at Fustat (Old Cairo) in 1965 was thought to be the earliest securely datable example of silver stain. The inscription in cursive Arabic contains the name Abd al-Samad b. Ali, who was believed to have governed Egypt briefly in AD 772. Unfortunately, this identification is incorrect and the object cannot be closely dated.[8] However, a vessel in the Museum of Islamic Art, Cairo, bears the date 163 AH in Coptic numerals, which is equivalent to AD 779–80.[9] A cup in the Corning Museum decorated in horizontal bands with geometric, calligraphic, and vegetal motifs may bear a similar date (**Pl. 2**).[10] Its inscription, in addition to naming the maker and the place of manufacture (see below), records the year in which it was made; however, the date is enigmatic. It begins with the numeral one, but the rest of the date is missing – unless it is concealed in the band of alternating Vs and dots above the inscription – an interpretation proposed by Carboni.[11] The Arabic numeral seven is shaped like a V and zero like a dot. Without a V and a dot, the date could be anywhere between 100 and 199 AH (AD 718 and 815). With a V and a dot, the date could be 107 (AD 725–6) or 170 (AD 786–7).

No later examples of silver stain that bear dates are known, and the chronology of silver-stained glass in and after the 9th century depends heavily on comparisons of its ornament with decorated objects in other media and the received opinion about the chronology of Islamic art in general. It is clear, however, that silver stain continued to be used – sparingly – after the introduction of gilded and enamelled decoration in the 12th century. A gilded and enamelled beaker (**Pl. 3**), which by common consent is attributed to a Syrian workshop in the mid-13th century, is decorated with a frieze of three polo players, bordered by two inscriptions.[12] The upper inscription is gilded and it has an enamelled red background painted on the interior of the beaker. The lower inscription, which has no background, is silver-stained (published descriptions do not mention the presence of silver stain, which was confirmed by visual inspection). Similarly, a vase in the Corning Museum (**Pl. 4**) has, among other ornament on the exterior, two gilded and enamelled rosettes, the petals of which are silver-stained on the inside of the object. The vase is believed to date from the second or third decade of the 14th century.[13]

Place of manufacture

Regarding the question of where early Islamic glass with silver stain was made, there is firm evidence for two places and somewhat tenuous evidence for a third. However, there is no need to suppose that production was restricted to two or even three places; there is simply no evidence at present for its manufacture elsewhere.

The first known place (or region) is Egypt. The inscription on the dated vessel in the Museum of Islamic Art, Cairo, also includes the words 'umila bi-Misr' ('made in Egypt').[14] Moreover, the sheer quantity of silver-stained fragments from Fustat (Old Cairo) points firmly towards Egypt as a manufacturing centre.

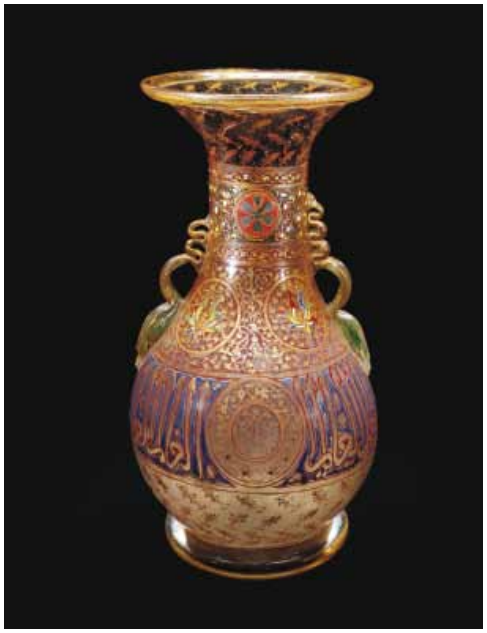


Plate 3 Beaker with polo players, mid-13th century, h. 15.5cm, d. 10.5cm. Musée du Louvre, Paris (A.O. 6131)

Plate 4 Vase, *c.* 1310–30, h. 30.2cm. The Corning Museum of Glass, Corning, New York (55.1.36)

The second place is Damascus. The dated cup in the Corning Museum (**Pl. 2**) is also inscribed with the names of the maker (Sunbat), and the place of manufacture (Damascus).[15] The manufacture of silver stain in Damascus is corroborated by a vessel, excavated at Raqqa, which also has an inscription stating that it was made there.[16] Syria, therefore, is a second region where silver stain was produced.

The last (but more doubtful) location is Basra in southern Iraq. Two fragments of silver-stained glass – one in the Princeton University Art Museum and the other in the Museum of Islamic Art, Cairo – are inscribed 'al-Basri' (from Basra), which Richard Ettinghausen took to be the *nisba* of the decorator.[17] Although this interpretation may be correct and the decorator may have come from Basra, it is just as likely – perhaps more likely – that he would have identified himself as being from Basra if he was working away from his home town (both of the fragments were found in Egypt).

Characteristics

Most early Islamic glasses painted with silver stain have combinations of vegetal motifs, animals and human figures, and inscriptions, sometimes in more than one colour. The technical and artistic skill of Islamic glass painters is evident in the production of multiple hues of translucent stain on a bowl in The Metropolitan Museum of Art which is decorated with stylized trees within roundels and narrow rectangular panels beneath an as-yet undeciphered inscription (**Pl. 5**).[18] The most remarkable stained-glass object surviving from the Islamic period is a bowl in the Corning Museum whose interior and exterior surfaces are decorated with three differently-coloured stains – golden yellow, purplish red and orange brown – depicting a bird, five fish, rosettes, and circular forms (**Pl. 6**).[19] The painted designs acquire different hues depending on the light passing through or reflecting off its surface. This was probably an unintentional result of the particular conditions of manufacture, which produced metallic particles of just the right size and density to achieve dichroism.

The '(re-)discovery' of silver stain in France

The history of silver stain, at least as told by scholars of European stained glass, traditionally skips from the Islamic world to western Europe, where it seems to appear as if out

Plate 5 Bowl, late 10th to early 11th century, h. 10.7cm, d. 15.3cm. The Metropolitan Museum of Art, New York (1974.74)

Plate 6 Bowl, 9th century, h. 6cm, d. 15.8cm. The Corning Museum of Glass, Corning, New York (99.1.1)

of nowhere on early 14th-century monumental painted windows. The addition of silver stain to the glass painter's repertoire completely transformed the appearance of decorated window glass in Europe, prompting Emile Mâle's oft-quoted comment that 'Rien ne ressemble moins à un vitrail du XIIIe siècle qu'on vitrail du XIVe' (nothing looks so unlike a window of the 13th century than one of the 14th century).[20] Before silver stain, in order to show different colours in their designs, glaziers depended on pieces of glass coloured throughout, known as 'pot-metal glass', cut to follow the shapes of the designs, and joined by thick lead cames which appear as dark outlines. The only means of modifying a single piece of coloured glass was with dark brown or black vitreous paint, which was used for details and shading.

The brilliant yellows and oranges achievable with silver stain revolutionized the design of painted windows by allowing glass painters to produce multiple transparent colours on one piece of glass, thus saving time in the cutting of the glass as well as avoiding the heavy black outlines of the lead. The introduction of silver stain was so important that to this day the English term for coloured monumental windows is 'stained glass', even when no stain is present. Silver stain even engendered its own genre of glass painting, in silver-stained roundels, which present intricately detailed scenes, utilizing different colours and shades of vitreous paint and stain on a single piece of colourless glass (round or rectangular), and which flourished in the Lowlands in the late 15th and 16th centuries.[21]

Early 14th-century examples of silver stain are found in England, in the Peter de Dene window of York Minster;[22] in Germany, in the Bible Window in Esslingen;[23] and in Switzerland, in the chapel at Königsfelden.[24] But the majority of early 14th-century silver-stained windows are found in France, particularly in Normandy. They include several windows at Rouen Cathedral[25] and one window at St Pierre in Mesnil-Villeman (Manche).[26] Only the window at Mesnil-Villeman is securely dated by an inscription, to 1313, and therefore it has been widely published as the earliest dated use of silver stain in Europe. Most of the other early windows can be dated stylistically to the years between 1300 and 1320. After 1320 silver stain was used throughout Europe.

The question of where the European glass painter's knowledge about the use of silver stain originated has been the focus of considerable speculation amongst scholars of stained glass. In 1943, at first unaware of the existence of silver stain on Islamic glassware, the great stained-glass historian Jean Lafond published an essay in which he cited a number of historic treatises which describe the use of silver stain but which do not shed much light on how the technique was discovered.[27] It was not until master glass painter Noël Heaton's seminal article on 'The origin and use of silver stain', published in 1948, that the first scholarly attempt was made to find a connection between the stains used on Islamic glassware and those on western European windows.[28] Charles Wilkinson, one of the excavators of Nishapur, in modern Iran, whose father was a glass painter, had realized that an early Islamic fragment of painted glass he found at Nishapur was silver stained and he informed Heaton of this important observation.

Realizing that silver-stained Islamic glass predated Europe stained-glass windows led to the question: did the knowledge of silver stain travel directly from the Islamic world to Europe (and, if so, how did it travel?), or did European glass painters 'discover' the technique for themselves? Heaton provided for both possibilities, first recounting a traditional story about a medieval glass painter who accidentally discovered the properties of stain when his silver button fell unnoticed onto a piece of glass just as it was being pushed into the kiln. The subsequent reaction which would produce silver stain is comparable to that occurring between gold foil and colourless glass to form gold ruby glass seen in some mosaic tesserae as described by Marco Verità in this volume (see p. 6). There is also abundant evidence that solid silver in contact with molten glass will produce silver stain, as shown by a Roman beaker of blue glass in the British Museum that was blown into a silver case with eight rows of oval holes through which the glass bulges.[29] In this instance, a mottled yellow-green stain is visible in several places where the molten glass came directly in contact with the silver, especially just below the rim where part of the silver cup has broken off, exposing the glass beneath. There certainly would have been innumerable opportunities for glass painters to observe the reaction between silver, glass, and heat that they could then use to their advantage; however, the tale of the careless French glazier must have seemed improbable to Heaton who didn't give it much credence.

Instead, Heaton proposed a vehicle by which the technology could have been transferred in the form of the *Lapidario* of Alfonso X, a treatise on the chemical and magical properties of stones, which was compiled and translated into Castilian from earlier sources, completed in 1279, and now in the library of the Escorial.[30] This treatise contains a recipe for colouring glass yellow by the application and heating of the mineral pyrargyrite (a silver antimony sulphide). Could a plausible case be made for the glass painters of France having access to this manuscript? In a 1986 article, Meredith Lillich proposed a hypothetical sequence of events involving royal marriages and diplomatic gifts, which she herself describes as 'castles in the air'.[31] And as Claudine Lautier recently noted, there is not one copy of the *Lapidario* of Alfonso X known in France and no documentary evidence that one had ever been brought there.[32] Rather, Lautier proposes that the technology of silver staining originated around 1300 in Paris, from where it spread to Normandy, despite the lack of evidence for its development in the capital. She notes the coincidence of several factors that could have led to the discovery of silver stain. These include a refined taste for luxury glassware – both the kind being produced in France and that being imported – which, she presumes, would have included silver-stained Islamic glassware, although by 1300 no Islamic glass decorated exclusively with silver stain was being produced and only gilded and enamelled Islamic glass is listed in the known inventories of the time. She also describes the rich artistic milieu which would have encouraged interactions between different specialized craftsmen who might have exchanged useful information. Finally, she notes the abundance of silver filings that would

Plate 7 Fragment of dish or bowl, 9th to 10th century, inside max. w. 11.1cm. The Metropolitan Museum of Art, New York (30.95.34)

Plate 8 Copy of the central part of the decoration on the inside of the fragment shown in Plate 7, made by Jean-Baptiste Hugenot, 2010

have been produced as a by-product of the production of silverware in Paris, which could then have served as a necessary ingredient for the production of silver stain. While this scenario is plausible, it certainly does not provide sufficient evidence of silver-stain technology in Paris around 1300.

Silver stain in the Byzantine Empire and adjacent regions

Another factor to consider is the growing evidence for the use of silver stain in the Byzantine Empire and among its neighbours and trading partners, which might help to explain the transmission of this technology from the Islamic world to medieval western Europe. Examples are few and scattered but there is every reason to believe that more will come to light. The following is a brief survey of eight silver-stained objects, five of which come from within the Byzantine Empire (numbers 1–5) and three which are believed to have been made outside the Byzantine Empire but by glassmakers who presumably were familiar with the Byzantine technique of silver staining (numbers 6–8).

(1) A fragmentary bowl in The Metropolitan Museum of Art, New York

In 1930, The Metropolitan Museum of Art acquired a fragment of a blue glass bowl decorated in mottled yellow on the inside with part of a hunting scene and on the outside with a band of stylized vegetal ornament (**Pl. 7**).[33] At the time, it was considered to be Early Christian – probably of Rhenish origin – and it was dated to the 4th century. In 1949 Frederic Neuberg published a photograph of the fragment in *Glass in Antiquity*, in the section devoted to gold glasses, and he dated it to the 1st or 2nd century.[34] The object was displayed in the Metropolitan Museum's 1977–8 exhibition 'Age of Spirituality' and in the catalogue Kathleen Shelton upheld the original attributions to the Rhineland and the 4th century.[35] Shelton described the medium of the decoration as 'enamel glaze'. Some years later a visiting scholar questioned the attribution of the fragment which was, consequently, submitted to a technical examination.

Compositional analyses revealed that the glass is typical Roman natron glass and that the decoration is silver stain. The identification of the silver stain was based not only on the fact that there is a concentration of silver at the surface in the areas of decoration, but also on the characteristic qualities of stain that were apparent. The decoration is not raised above the surface of the glass, the colour ranges from whitish green to mustard yellow, is slightly mottled, and is relatively opaque. It also exhibits a faint white 'halo' around the painted areas and, in some areas, a metallic iridescence. It was difficult to reconcile the use of silver stain on what seemed to be a Roman glass object, until two additional factors were considered. The cobalt used to colour the glass blue was associated with zinc and use of this particular ore is generally reported to have occurred no earlier than the 9th century. In addition, the schematic palmettes and leaf-like elements in the decorative band on the bottom of the bowl are typical of Byzantine decorative arts from the 10th to 12th century, and can be compared with decorative elements on certain Middle Byzantine glazed pottery with scratched ornament as well as on the San Marco bowl, arguably the best-known Byzantine glass vessel (discussed below). The Metropolitan Museum's fragment also exhibits other similarities to the San Marco bowl, such as a solid applied foot ring, a small circular pontil mark with little excess glass, and figural ornament that recalls the art of the Roman world. The San Marco bowl is usually dated to the 10th century and the composition of the glass of the Metropolitan Museum's fragment would fit with a 9th to 10th century dating – that is, in the last years of the production of natron glass, and the first years of the use of cobalt associated with zinc. With this reattribution, the fragment became the first recognized example of the use of silver stain on Byzantine glass.

The initial difficulty in recognizing the silver stain on the Metropolitan Museum's fragment was due to its unexpected appearance. When yellow stain is found on 14th-century and later stained-glass windows, the transparent colour is used to alter the colour of the base glass – colourless glass becomes yellow, blue glass becomes green, and so on. However, on the fragment from the Metropolitan Museum and other Byzantine examples described below, the stain is rather opaque, appearing more like enamel. It has already been noted that the appearance of the stain is affected by several

Plate 9 Bracelet, 12th to 13th century, d. 7.5cm. The Metropolitan Museum of Art, New York (67.185)

factors, including the temperature and time of firing. Firing stain at too high a temperature or for too long will result in the formation of larger and more densely spaced silver particles, which can cause it to appear opaque. This effect can be seen in a copy of the central part of the decoration on the inside of the Metropolitan Museum's bowl fragment (**Pl. 8**) which was produced by deliberately firing the stain at a higher than usual temperature. The same range of colours, mottling, and haloes are seen in the copy as on the original fragment.

(2) Silver-stained bracelets

The Metropolitan Museum's collection also includes a blue glass bracelet which was said to have been found near Iznik, Turkey, and had been dated between the 12th and the 14th centuries (**Pl. 9**).[36] Examination of the bracelet revealed that all of the decoration, apart from some of the wavy horizontal lines – which were gilded – consists of a mottled, relatively opaque, silver stain. The stain is mostly whitish-yellow, but in some areas it has a blue or bluish-violet colour which makes it seem to disappear on the blue glass background. This phenomenon, known to glass painters as 'metalling', is another effect that can occur when stain is fired at too high a temperature or for too long and the silver particles form in such a way as to regain their metallic appearance. It is quite often seen on the outside of stained-glass windows, where it acquires a bluish reflective sheen.

Bracelets like the example in the Metropolitan Museum have been found at sites throughout the Byzantine world. Most of them are made of deep green blue, or purple glass, and, in addition to gilding and silver stain, the decoration may include green, red, or yellow enamel. Find places extend from the Balkans through Greece and Bulgaria to Turkey and the range of dates to which they are attributed begins in the 10th century and ends in the 12th or 13th century. Most publications of these bracelets have described the decoration in ambiguous terms, calling it 'painted' or 'enamelled' without recognizing the existence of silver stain. However, examination of bracelets in the Museum of Byzantine Culture, Thessaloniki, the Archaeological Museum, Istanbul, and the Victoria & Albert Museum, London, revealed the presence of silver stain on almost all of them.

(3) The bowl in the Treasury of San Marco, Venice

Soon after the identification of silver stain on the two Byzantine glasses at the Metropolitan Museum, a cursory observation of the famous painted bowl on display in the treasury of San Marco in Venice seemed to reveal silver stain as well.[37] The bowl is normally reproduced in a direct profile view in publications because this view shows the gilded and enamelled decoration on the body to best advantage. But, this obscures the painted inscriptions on the inside of the rim and around the foot.[38] However, the placement of the bowl in the vitrine in the Treasury allows it to be seen from slightly above and below revealing what appeared to be silver stain in the inscriptions.

A close examination of the bowl out of its vitrine undertaken by a group of glass scholars, which included the current authors, William Gudenrath, Marco Verità and Mark Wypyski, confirmed that the inscription on the inside of the rim was silver stained (**Pl. 10**), while that on the outside of the wall was painted in yellow enamel, about half of which is now lost. The silver-stained inscription has similar characteristics to the decoration on the Metropolitan Museum's bowl fragment and bracelet. It is pale yellow, in some places with a light bluish tinge, and some of the painted lines have faint off-white 'haloes'.[39]

Recognizing the use of silver stain on the San Marco bowl confirmed that the Metropolitan Museum's fragment was not an anomaly and that silver staining was certainly practised by Byzantine glassworkers in the 10th century, not only on relatively modest bracelets, but also on high-quality vessels. Once this fact had been established and disseminated within the community of glass scholars and opportunities arose to explain to colleagues how to distinguish silver stain from enamel, further examples were revealed and the widespread use of silver stain both within the Byzantine Empire and among its neighbours and trading partners began to become apparent.

(4) Yumuktepe

Among the finds excavated at Yumuktepe near Mersin, southern Turkey, were two fragments of blue glass vessels decorated with silver stain (**Pls 11–12**).[40] The mound contains the superimposed remains of settlements that date back to the prehistoric period. The glass fragments were found in deposits of the 11th to 12th century. Each fragment includes part of the rim of a vessel and is decorated on the outer surface with palmettes, swirls, and – in the case of the slightly larger fragment – dotted lines, all reminiscent of the decoration on the outside of the fragment in the

Plate 10 Detail of the silver-stained inscription on the San Marco bowl. Treasury of San Marco, Venice

Plate 11 Rim fragment from Yumuktepe, 11th to 12th century. Mimar Sinan Fine Arts University, Istanbul

Plate 12 Rim fragment from Yumuktepe, 11th to 12th century. Mimar Sinan Fine Arts University, Istanbul

Metropolitan Museum and the San Marco bowl. The decoration has been published as 'enamelled', but subsequent discussions with Gulgun Köruğlu about the different characteristics of stain and enamel led to the conclusion that they are silver-stained.

(5) Aquileia

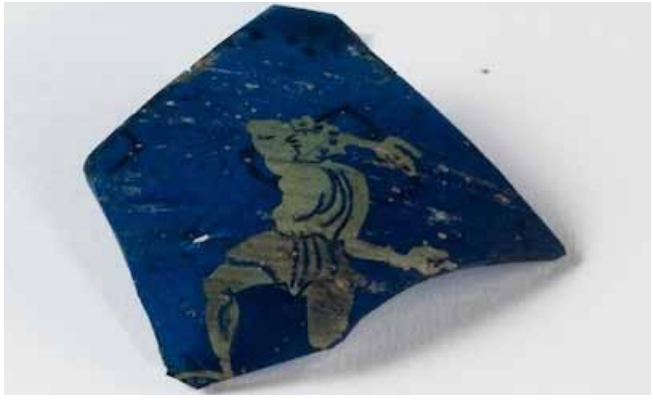
A fragment of a blue glass bowl, decorated in yellow with a figure on the outside and with floral motifs on the inside (**Pl. 13**) was found in the storeroom of the Galleria Nazionale d'Arte Antica, Trieste, by Luciana Mandruzzato, who is preparing a catalogue of the glass collection. Museum records indicate that the fragment was found at Aquileia.[41] Examination of the fragment by Whitehouse again confirmed that the decoration is silver stain. The figural painting on the fragment bears a very close resemblance to the painting on the fragmentary bowl in the Metropolitan Museum; indeed, one could imagine that the two objects were painted in the same workshop, perhaps by the same hand.

(6) Zalavár

Zalavár, in the marshes west of Lake Balaton in southwestern Hungary, is the site of a pilgrimage church built and dedicated between about AD 855 and 870.[42]

Plate 13 Bowl fragment from Aquileia, late 10th to early 11th century. Galleria Nazionale d'Arte Antica, Trieste

Plate 14 Window glass fragments from Zalavár, 9th century. Hungarian National Museum, Budapest



Excavations on the site of the church and an associated glass workshop that produced windowpanes for glazing the church yielded a number of window fragments. Most of the glass was coloured and had been grozed to form a variety of geometric shapes. Among the light green fragments were several with silver stain (**Pl. 14**) whose ornament includes at least three faces, a hand, and parts of an inscription.

(7) Uherské Hradiště-Sady

Two fragments of painted window glass were excavated in a church complex at Uherské Hradiště-Sady in the Czech Republic, the most important Christian centre in the Great Moravian Empire, which was built and occupied in the second half of the 9th century (**Pls 15–16**).[43] A number of finds at the site suggest contact with the Byzantine Empire. Whitehouse examined these fragments in the museum at Brno and confirmed that the decoration is silver stain.

(8) San Lorenzo di Ammiana

Francesca Vaghi, Marco Verità, and Sandro Zecchin reported a fragment of light green glass painted with silver stain, probably from a church on the small island of San Lorenzo di Ammiana in the Venetian Lagoon to the north

Plate 15 Window glass fragment from Uherské Hradiště-Sady, 9th century. Moravian Museum, Brno

Plate 16 Window glass fragment from Uherské Hradiště-Sady, 9th century. Moravian Museum, Brno

of the islands of Burano and Torcello (**Pl. 17**).[44] This fragment, together with other window glass from the site, is attributed to some time between the 9th and the 11th centuries. The authors had known about this fragment for some time before publishing it but could not reconcile the existence of silver stain on a glass with a 'Roman' (i.e. natron-based) composition until the publication of the Metropolitan Museum's examples.[45] Now it forms part of the growing corpus of silver-stained glass of the Middle Byzantine period.

Conclusion

Following this survey of early silver-stained glass, some conclusions can be drawn, but many questions remain. Its exact origins are still unknown, but the use of silver stain by Islamic craftsmen to decorate glass vessels was firmly established by the late 8th century. Although it did not appear on a large scale in western European windows until the late 13th or early 14th century, it seems to have been widely used by craftsmen throughout the Byzantine Empire and in areas influenced by or in contact with it in the 9th to 11th centuries. This fact has long been overlooked by scholars of European stained-glass windows, in part because they tend to study only full-scale panels, generally ignoring archaeological finds and fragments. But the lack of European examples of silver stain between the 11th and 14th centuries leaves open the question of whether there really was continuity with the Byzantine world or whether silver stain was discovered independently in France.

There is a fundamental difference between the appearance of stain on Byzantine glasses and European windows. Byzantine silver stain is almost always opaque, appearing more like yellow enamel. It is used on a small scale and the designs are achieved by applying the stain linearly or by filling in an area and scratching out the lines. What is new and surprising about the appearance of silver stain on European windows after 1300 is its brilliance and transparency, as well as its ability to modify coloured glasses or vitreous paint. The production of transparent silver stain is dependent in part on the composition of the base glass and on the ability to control the firing temperature very precisely, so the apparent change in the 14th century may also be due to technological improvements in glassmaking and/or furnace construction. Finally, western European windows employing silver stain are generally composed of much larger individual pieces of glass than the few Byzantine silver-stained window glass fragments identified so far. Was this also a technological issue, whether related to the production of flat glass, available furnace technology, or the construction of the buildings in which the windows were seated?

These questions might be answered when more examples of early European silver stain come to light as they no doubt will. Hopefully, archaeologists working with this material will carefully examine the painted glass to distinguish more clearly between enamels and stain and European stained-glass historians will turn their attention to this early material so the rest of the story of silver stain can be illuminated.

Plate 17 Window glass fragment from San Lorenzo di Ammiana, 9th to 11th century. Private collection, Venice

Acknowledgements

The authors gratefully acknowledge the contributions of the following colleagues: László Czifrák, Luciana Mandruzzato, Gulgun Köroğlu, Ágnes Ritoók, Hedvika Sedláçková, Mary B. Shepard, Sebastian Strobl, Marco Verità and Mark T. Wypyski.

Notes

1 J. Pérez-Arantegui, J. Molera, A. Larrea, T. Pradell, M. Vendrell-Saz, I. Borgia, B. Brunetti, F. Cariati, P. Fermo, M. Mellini, A. Sgamellotti and C. Viti, 'Luster pottery from the thirteenth century to the sixteenth century: a nanostructured thin metallic film', *Journal of the American Ceramic Society* 84 (2) (2001), 442–6.

2 W. Vogel, *Chemistry of Glass*, trans. from *Glaschemie* by N. Kreidl, Westerville, Ohio, 1985, 174–7; I.C. Freestone, N. Meeks, M. Sax and C. Higgitt, 'The Lycurgus Cup – a Roman nanotechnology', *Gold Bulletin* 40 (4) (2007), 1–8.

3 Vogel (n. 2), 177.

4 J. Molera, C. Bayés and P. Roura, 'Key parameters in the production of Medieval luster colors and shines', *Journal of the American Ceramic Society* 90 (7) (2007), 2245–54.

5 C.J. Lamm, *Oriental Glass of Mediaeval Date Found in Sweden and the Early History of Lustre-Painting* (Kungl. Vitterhets Historie och Antikvitets Akadamiens Handlingar 50 [1]), Stockholm, 1941, 18–19.

6 S. Carboni, *Glass from Islamic Lands*, New York, 2001, 200.

7 S. Carboni and D. Whitehouse, *Glass of the Sultans* (exh. cat., Corning Museum of Glass, Metropolitan Museum of Art, New York, Benaki Museum, Athens), New York, 2001, 209–11, no. 103.

8 S.M. Goldstein, *Glass: From Sasanian Antecedents to European Imitations* (The Nasser D. Khalili Collection of Islamic Art, 15), ed. J. Raby, London, 2005, 134.

9 G.T. Scanlon and R. Pinder-Wilson, *Fustat Glass of the Early Islamic Period: Finds Excavated by The American Research Center in Egypt*, London, 2001, 110–11, no. 45a.

10 Carboni and Whitehouse (n. 7), 208–9, no. 102.

11 Ibid., 209.

12 S. Makariou, 'Gobelet', in É. Delpont (ed.), *L'Orient de Saladin: l'art des Ayyoubides* (exh. cat., Institut du monde arabe, Paris), Paris, 2001, 191, no. 204.

13 Carboni and Whitehouse (n. 7), 265, no. 131.

14 Goldstein (n. 8), 134.

15 Carboni and Whitehouse (n. 7), 208–9, no. 102.

16 Ibid., 208.

17 R. Ettinghausen, 'An early Islamic glass-making center', *Record of the Museum of Historic Art, Princeton University* 1(2) (1942), 4–7, esp. 5.

18 Carboni and Whitehouse (n. 7), 218–19, no. 108.

19 Ibid., 213–15, no. 105.

20 E. Mâle, 'La Peinture sur verre en France', in M. André (ed.), *Histoire de l'art depuis les premier temps chrétiens jusqu'à nos jours* 2 (1), Paris, 1906, 372–96, esp. 392.

21 T. Husband, *The Luminous Image: Painted Glass Roundels in the Lowlands, 1480–1560* (exh. cat., Metropolitan Museum of Art, New York), New York, 1995.

22 N. Heaton, 'The origin and use of silver stain', *Journal of The British Society of Master Glass-Painters* 10 (1) (1948), 9–16, esp. 9.

23 M. Burger, 'Die Glasmalereien der Esslinger Franziskanerkirche', in K. Fast and J.J. Halbekann (eds), *Zwischen Himmel und Erde: Klöster und Pfleghöfe in Esslingen*, Esslingen, 2009, 203–9, esp. 208.

24 B. Kurmann-Schwarz, *Die Mittelalterlichen Glasmalereien der ehemaligen Klosterkirche Königsfelden*, Corpus Vitrearum Medii Aevi Schweiz, 2, Bern, 2008, 126.

25 J. Lafond, *Les Vitraux de l'Église Saint-Ouen de Rouen*, Corpus Vitrearum Medii Aevi France, 4 (2/1), Paris, 1970, 45.

26 C. Lautier, 'Les Vitraux', in D. Gaborit-Chopin (ed.), *L'Art au temps des rois maudits: Philippe le Bel et ses fils 1285–1328* (exh. cat., Grand Palais, Paris), Paris, 1998, 377–93, esp. 390–2, no. 303.

27 J. Lafond, 'Essai Historique sur le Jaune d'Argent', in *Pratique de la Peinture sur Verre à l'Usage des Curieux suivie d'un Essai Historique sur le Jaune d'Argent et d'un Note sur les plus Anciens Verres Gravés*, Rouen, 1943, 39–116.

28 Heaton (n. 22).

29 D.B. Harden, H. Hellenkemper, K. Painter and D. Whitehouse, *Glass of the Caesars* (exh. cat., British Museum, London, Römisch-Germanisches Museum, Cologne, Palazzo Reale, Milan), Milan, 1987, 156, no. 78.

30 Ms h.I.15.

31 M.P. Lillich, 'European stained glass around 1300: the introduction of silver stain', in E. Liskar (ed.), *Europäische Kunst um 1300* (Akten des XXV. Internationalen Kongresses für Kunstgeschichte 6[6]), Vienna, 1986, 45–60.

32 C. Lautier, 'Les débuts du jaune d'argent du vitrail ou le jaune d'argent à la manière d'Antoine de Pise', *Bulletin Monumental* 158 (2) (2000), 89–107.

33 D. Whitehouse, L. Pilosi and M. Wypyski, 'Byzantine silver stain', *Journal of Glass Studies* (hereafter *JGS*) 42 (2000), 85–96.

34 F. Neuberg, *Glass in Antiquity*, London, 1949.

35 K.J. Shelton in K. Weitzmann (ed.), *Age of Spirituality: Late Antique and Early Christian Art, Third to Seventh Century* (exh. cat., Metropolitan Museum of Art, New York), New York, 1979, 86, no. 75.

36 Whitehouse, Pilosi and Wypyski (n. 33).

37 D. Whitehouse and L. Pilosi, 'Byzantine silver stain: another example?', *JGS* 43 (2001), 180–1.

38 K.R. Brown, 'Gilded and painted glass bowl', in D. Buckton (ed.), *The Treasury of San Marco Venice* (exh. cat., Musée du Louvre, Paris, Metropolitan Museum of Art, New York, British Museum, London), Milan, 1984, 181–3, no. 21.

39 W. Gudenrath, L. Pilosi, M. Verità, D. Whitehouse and M. Wypyski, 'Notes on the Byzantine painted bowl in the Treasury of San Marco, Venice', *JGS* 49 (2007), 57–62.

40 G. Köroğlu, 'Selected medieval glass artifacts from Yumuktepe mound', *Studi di Antichità* 11 (1998), 283–94, esp. 287–8, figs 5–6. Although only one of these fragments (**Pl. 11**) was published in the article on the glass finds from Yumuktepe, both were shown on a poster presented at the 18th congress of the Association Internationale pour l'Histoire du Verre in Thessaloniki, 21–5 September 2009.

41 L. Mandruzzato, 'Un frammento di coppa bizantina con decorazione *silver stain* da Aquileia', in A. Coscarella (ed.), *Il vetro in Italia: testimonianze, produzioni, commerce in età basso medieval. Il vetro in Calabria: vecchie scoperte, nuove acquisizioni*, Atti XV Giornate Nazionale di Studio sul Vetro A.I.H.V, Università della Calabria, Aula Magna, 9–11 guigno 2011, Richerche Collana del Dipartimenta di Archeologia e Storia delle Arti VII, Arcavacata di Rende (Cs), University of Calabria, 2013, 613–17.

42 B.M. Szöke, K.H. Wedepohl and A. Kronz, 'Silver-stained windows at Carolingian Zalavár, Mosaburg (Southwestern Hungary)', *JGS* 46 (2004), 85–104.

43 L. Galuška, J. Macháček, K. Pieta, and H. Sedláčková, 'The glass of Great Moravia: vessel and window glass, and small objects', *JGS* 54 (2012), 61–92, esp. 75, 78, fig. 9.1, 81, fig. 10.27, and 82.

44 F. Vaghi, M. Verità and S. Zecchin, 'Silver stain on Medieval window glass excavated in the Venetian lagoon', *JGS* 46 (2004), 105–8.

45 Verità pers. comm. 2010.

Chapter 30
Victorian or Justinianic? Painter or Practitioner? *In Situ* or Reverse?
The Mosaicing of Westminster Cathedral

Paul Bentley

Westminster Cathedral in London is a Victorian building in the Early Byzantine style. This prompts the question: should its mosaics be in a Justinianic or Victorian style? Or some other style? Other questions suggest themselves. Should a mosaicist be commissioned, or should a painter do a design and a mosaicist make it? Should the method used be direct or indirect? Should the mosaics be figurative or non-figurative? Is it possible to stop cartellinae falling off gold and silver tesserae? Is it possible to stop tesserae falling onto worshippers thirty metres below? Should a lime plaster setting bed be used, or mastic or cement or a modern adhesive? Should the wishes of the architect, John Francis Bentley (no relation), be paramount?

These questions are not academic, because at the time of writing (2012) the Westminster authorities are thinking of completing the mosaicing of the high vaults and domes, all the upper regions of the main body of the cathedral in fact, over the course of the next several years. Mosaicing some 8000m^2 will be quite a task (**Pl. 1**).[1]

In this paper I will describe how and why the designers and mosaicists responsible for the existing mosaics were commissioned. I will evaluate the styles and techniques employed, and will conclude by considering the questions of technique and commissioning which should be borne in mind in the future.

There was irony at work even at the design stage of the new church. The founder, Cardinal Vaughan, and Bentley chose to build a Byzantine cathedral, not the normal style for the architect, who was best known for his 'Victorian Gothic' churches.[2] In 1894 therefore Bentley visited Byzantine churches and Roman remains in Italy and studied William Richard Lethaby and Harold Swainson's book on Hagia Sophia.[3] On his return he wrote that the arrangement of his cathedral was 'not that of an Eastern church of the Justinian period', meaning churches which had a centralized form. Instead it would be arranged from 'a congregational standard'. It would have a long nave, in other words.[4] It is evident that he did not know about the Justinianic church of St John at Ephesus, which distinctly resembled Westminster Cathedral.[5]

St John's had a long nave, four domes over square bays, and galleries, like Bentley's cathedral. The proportions are comparable – the Westminster nave is 200ft (61m) long, the width 60ft (18m); the corresponding figures in St John's were 210ft (64m) by 50ft (15m). The main differences are that St John's had no deep barrel vaults north and south of the nave; the high altar was sited at the crossing, not in the sanctuary; and the transepts were domed. Additionally, Bentley 'clipped on' 12 chapels round his cathedral. Nevertheless he unknowingly designed a church in the Early Byzantine style. More irony followed: in 1902, as the basic structure was nearing completion, Bentley wrote in the first *Guide to the Cathedral* that the style was 'early Christian Byzantine'.[6] Perhaps a Byzantinist had had a word in his ear. In terms of the mosaics of the building, does this mean they should be in that style? What did the architect himself think suitable? [7]

Decorating Westminster Cathedral: questions of mosaics and style

When plans for decoration were first discussed, it was decided to proceed with three 'experimental' chapels,

Plate 1 Interior, Westminster Cathedral

despite Bentley's 'earnest desire that a unified scheme for nave and aisles should precede the individual plans for the chapels'.[8] Crucially, Bentley did not seek out experienced mosaic artists; instead he invited the painters William Christian Symons and John Singer Sargent to design two chapels, saying he would do the third. This set a precedent, followed even today by the cathedral's Art and Architecture Committee, for commissioning designs from artists who know little or nothing about using mosaic as a medium. Bentley was aware of the problem and attempted to deal with it by being willing to work closely with the designer and the mosaicists responsible for executing the design.

Sargent declined the invitation and Bentley died before he could design a chapel, but Christian Symons offered to design the mosaics in the Holy Souls Chapel. Bentley wrote: 'We must avoid anything pictorial, and the drawing must be severe and very Greek in character.'[9] By 'pictorial' he presumably meant that the mosaics should not have detailed naturalistic scene setting and linear perspective with vanishing points. By 'Greek' he must have meant Byzantine, probably in the style of mosaics he had seen in St Mark's, Venice, and at Ravenna. He agreed to Symons' suggestion of depicting the Three Youths in the Fiery Furnace on the west wall (a scene used at Hosios Loukas, Greece), but was less certain about depicting Adam and Eve on the north and south walls (in the event Christ, the second Adam, replaced Eve). He himself suggested representing Purgatory on the east wall, with the archangels Michael and Raphael. Again he emphasized, 'I am convinced that for mosaic the design should be simple, and the style Greek in character.'[10]

It is not known what research Symons did into Byzantine mosaics, but what he produced was not remotely 'Greek'; it was sentimental Victorian *art nouveau* on a silver ground (**Pl. 2**). Did Bentley approve? He visited Symons' studio, 'advising and supervising in the production, first of the sketches, and then of the full-size cartoons, and afterwards watching closely over the technique of reproduction, when these were handed over to Mr Bridge and his mosaicists at the Oxford Street Studio'.[11] Bridge wrote, 'When I began work and asked Mr Bentley for instructions as to the method of execution, he told me to go ahead and translate the cartoons into mosaic. We started on the little winged busts of the ten Mercies in the Holy Souls Chapel and these obtaining, without alteration, the approval both of Mr Bentley and of Mr Symons, set the key for the whole of the mosaic in the chapel....'[12] At first the reverse method was used, in the studio, but it was quickly abandoned in favour of working *in situ*. Indeed Bridge says Bentley did not approve of the 'modern Italian' reverse method, 'a procedure which renders the work utterly flat and lifeless'.[13] He wanted 'an individual to be responsible for the execution of the mosaic – not a firm – and thus (have) a direct personal interest as opposed to the supervision of a foreman...'. [14] The tesserae, smalti plus silver and gold, were from Italy; the manufacturer is not known. As for the setting bed, Bentley did not mind whether it was water cement or oil mastic, 'always providing that the mosaic was worked *in situ* on the walls'.[15]

Bentley never saw the completed mosaics, as he died in March 1902 and his biographer-daughter Winifrede de L'Hôpital tells us that the mosaicists started work in the chapel in June 1902, finishing in November 1903.[16] It is

Plate 2 East wall, Holy Souls Chapel

Plate 3 Bentley's Adoration of the Magi, Holy Souls Chapel

Plate 4 East Wall, Chapel of St Gregory and St Augustine

certain however that Bentley approved Symons' design. In this context one approach to completing the cathedral mosaics now would be to accept that Bentley envisaged what we now call a Victorian style and to seek to reproduce that style, recognizing that the architect would have wanted the *in situ* method to be used (**Pl. 3**).[17]

More irony quickly followed: the mosaics of the next chapel, dedicated to Sts Gregory and Augustine, ignored Bentley's wishes, thus setting another precedent. The donor, Lord Brampton, insisted that the firm of Clayton and Bell undertake the design and installation. Clayton met Bentley, who spoke emphatically against the importation of any Gothic spirit into the designs but was not otherwise involved.[18] Work began in 1902 and was completed by 1904. The chapel commemorates the saints who evangelized England in the 5th century. The mosaics show two 'scenes': Pope Gregory sending Augustine and his companions to England, and their reception by the King and Queen of Kent. There are also images of individual English saints.

The designer Clayton claimed to be a 'modernist'. De L'Hôpital writes: 'The late Mr Clayton's faith in progress in art, and his belief that the attempt to resuscitate the dead in styles of art is a profound mistake, are the reasons given for employing a treatment so remote from the methods of the Byzantine workers.'[19] What he produced were mosaics in the full Victorian Gothic mode. Bentley would have disapproved, also because the two scenes are more 'pictorial' than Symons' (**Pl. 4**). Worse, Clayton used the 'modern Italian' reverse method, in which the mosaic is made off site.[20]

Interestingly Clayton's view on 'dead art' has been echoed in our time by Tom Phillips, who designed a panel depicting Cardinal Newman in 2008 and the Chapel of St George. Phillips disapproves of any attempt to create neo-Byzantine mosaics for the cathedral because he thinks it is not a Byzantine church, but Victorian.[21] But Bentley and Symons, both Victorians, wanted to create Byzantine-style mosaics.

After Bentley and Vaughan's deaths in 1902 and 1903 they were replaced by John Marshall, Bentley's chief assistant, and Cardinal Bourne. Bourne took the job seriously, even visiting Sicily to see the Byzantine mosaics at Monreale and Palermo. The 'experiments' in mosaic continued: in 1911 Bourne gave permission for Marshall to design the small Chapel of the Sacred Heart. A depiction of the Face of Christ by Symons was included. But the donor did not like the Christ and in a few years the mosaics were threatening to fall off, so in 1916 Marshall replaced them with the present floral design on gold and red grounds and a new Face of Christ. He used a different firm to install them (**Pl. 5**).

Meanwhile, in 1912, the cardinal employed Robert Anning Bell, who had designed mosaics for the Houses of Parliament, to design for the Lady Chapel an altarpiece of the Virgin and Child, and four niches of Daniel, Ezekiel, Jeremiah and Isaiah. They were made by Gertrude Martin and colleagues; the same team who had worked on the Holy Souls and Gregory chapels. The Virgin and Child are in the Byzantine tradition: the pose is the 'Virgin Eleousa' (loving kindness), and the shell-pattern blue ground derives from a

Plate 5 Detail of the mosaics in the present Sacred Heart Chapel

Plate 6 Detail of cities in the mosaics in the Chapel of St Andrew

panel in St Mark's, Venice. The prophets are drawn in the Victorian mode.

In 1914 an attempt was made to design the Chapel of St Andrew in the Byzantine style. Once again the donor, the fourth Marquess of Bute, insisted on choosing the artist. He was Robert Schultz, an authority on Byzantine art. The mosaic work was carried out by a group of mosaicists under the direction of Gaetano Meo, who had been Sir William Richmond's assistant with the mosaics of the quire in St Paul's. One wall depicts St Andrew, with a lengthy inscription about the saint (not a Byzantine practice); another wall shows the cross of St Andrew. A gold ground is used throughout, and on the ceiling the *andamento* is a beautiful fish-scale design, which reminds us that Andrew was a fisherman. On the lower part of the ceiling six cities associated with St Andrew are shown, such as Patras in Greece and Milan in Italy.

Despite Schultz's alleged expertise these mosaics are not fully Byzantine in style. The cities could hardly be more 'pictorial', complete with scenery, perspective and vanishing points – precisely what Bentley did not want (**Pl. 6**). The west wall is more successful in that respect, with its traditional deer and vegetation and St Andrew portrayed simply, hands raised in the 'oremus' pose (**Pl. 7**).

By this point four chapels had been completed, together with the Lady Chapel altarpiece and niches, a panel depicting St Joan (designed by Symons) and the exterior tympanum over the main entrance to the cathedral, another design by Bell that Bourne described as 'the greatest disappointment which I have received in connection with the work of the Cathedral'.[22] He admitted he found the whole question of the mosaics most perplexing.

However in 1923 Bourne had his portrait painted by Gilbert Pownall and became convinced he had found the right man for the mosaics. One reason was that Pownall was a Catholic, and the cardinal had become convinced that only a Catholic artist could interpret the Catholic faith satisfactorily, a debatable opinion, though one still found today. Pownall was yet another painter with little or no experience of the mosaic medium, so Bourne sent him and Marshall to Ravenna, Rome, Venice and Sicily to study the mosaics there. Meanwhile Bourne set up a mosaic workshop at the cathedral.

Between 1926 and 1935 Pownall designed and supervised the making of mosaics for a confessional alcove in the south transept, the large tympanum above the sanctuary, the great sanctuary apse, the crypt and the upper areas of the Lady Chapel. Pownall's scheme for the Lady Chapel includes all the principal episodes from the life of the Virgin. The focus is the apse, where a Tree of Life (probably inspired by the vine in the apse of St Clemente, Rome) is flanked by St Peter and a glamorous Mary, the Tower of London and Westminster Cathedral, angels and saints. The Tree of Life supports Christ on a rainbow, in a mandorla borne by angels, inspired by the Pantocrator in the Ascension Dome in St Mark's, Venice (**Pl. 8**).

The frieze around the chapel depicts 20 scenes from the life of Mary, perhaps inspired by a sequence in the Chora

Plate 7 St Andrew, west wall, Chapel of St Andrew

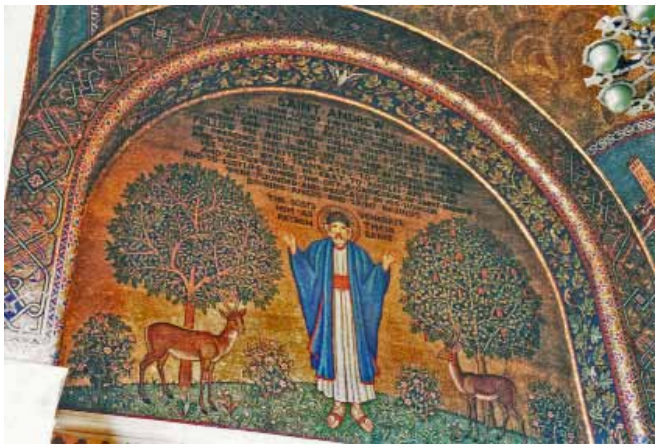


Plate 8 Detail of the apse mosaics, Lady Chapel

Plate 9 Detail of the wall mosaics, Lady Chapel

Plate 10 Detail of sanctuary tympanum mosaics, designed by Gilbert Pownall

church in Constantinople. Above this there are larger pictures of scenes and individuals connected to Our Lady, such as the Pope defining the Immaculate Conception (**Pl. 9**). The west end has the Coronation of Our Lady, flanked by seraphs like those in the narthex of St Mark's. The window soffits show flowers and fruits derived from those in the Mausoleum of Galla Placidia in Ravenna.

Thus the spirit of Byzantium hovers over this chapel, though the design style itself is a cross between Late Byzantine and streamlined Pre-Raphaelite. It has also been likened to the style of a child's illustrated Bible by those not in a mood to compliment the images. It is true that Pownall's Virgin lacks the haunting melancholy so characteristic of Byzantine images of Mary, and that linear perspective is used in depicting buildings, which was not a Byzantine practice.

Pownall next designed the tympanum above the sanctuary. It shows Jesus seated on a rainbow with his feet on a globe, once again inspired by the Pantocrator in the Ascension Dome in St Mark's, Venice. He is attended by the traditional symbols for the four evangelists. Not at all Byzantine however is the blue heaven made up of the myriad faces of the faithful. Moreover the apostles gazing at Jesus are shown in full profile. In Byzantium the norm was for Jesus, Mary, angels and saints to be shown with both eyes visible, as they were thought of as engaging directly, face to face, with the worshipper. Only the evil, such as Judas, were shown in profile. It is evident from their designs that Bentley, Symons, Clayton, Bell and Pownall ignored or, more probably, did not know this (**Pl. 10**).

Pownall then moved on to begin designing the sanctuary apse. Meanwhile, trouble. All the cathedral mosaics to date had had admirers and detractors, but when the Lady Chapel apse and the tympanum were revealed a real crisis erupted. Edward Hutton, an expert on Italian and Byzantine art, savagely attacked Pownall's work in a letter to the *Daily Telegraph* as 'meaningless, weak and incoherent… puerile and unmasterly'.[23] Cardinal Bourne defended Pownall equally passionately, insisted that work on the apse be continued, but then died. He was replaced by Cardinal Hinsley, and Hutton continued his attack, supported by the Presidents of the Royal Academy and the Catholic Art Guild, the directors of the Tate Gallery and the National Gallery and others.[24]

The upshot was that Hinsley agreed to the formation of a committee to advise him on the design and to watch over the execution of future mosaics. Their first job was to remove as much of Pownall's sanctuary apse mosaic as had been installed, about a quarter of the whole. The apse is still bare. The tympanum ('seeming to involve the whole great church in little less than ruin', according to Hutton) survives. At the time various artists were invited to submit new designs for these, but nothing was done. It seems that no-one at this stage was influenced by Bentley's 'earnest desire' for a unified scheme for the nave and aisles, and his wish that the first move should be 'the formulation on broad lines of a general scheme for the mosaics'.[25] A piecemeal approach was taken for granted, a notion not unknown today.

However the advisory committee was a whole new factor in terms of commissioning new mosaics. At first it consisted of a painter, a trustee of the National Gallery, an expert on medieval wall painting and two clergymen. Later on they were joined by Hutton himself and by the President of the Royal Institute of British Architects. However, there was no one with professional expertise on mosaic, thus setting yet another precedent. It appears that no one questioned whether it was possible for a committee to commission successful mosaics if no member had actual experience of working with the medium, or had spent time closely observing mosaicists at work.

In the 20 years after Pownall, the only mosaics commissioned by the committee were an over-busy panel of Christ the Divine Healer by Michael Leigh (Catholic) and an anaemic one of St Teresa of Lisieux by John Trinick (Catholic).[26] But then, in 1956, urged on by Sir John Rothenstein, a committee member who was the Director of the Tate Gallery, a chapel was commissioned from a mosaic artist, and what was more, a Russian who knew all about Byzantine mosaics. Boris Anrep had in fact made an unfinished mosaic in the crypt in 1914 and a panel of the Blessed Oliver Plunkett for Cardinal Bourne in 1924. But now he was to undertake the Blessed Sacrament Chapel. The brief was for a scheme which embodied themes associated with the Eucharist and the Trinity. Anrep obliged: the nave is devoted to Old Testament types of those subjects, such as the sacrifices of Abel and Noah, and the sanctuary to New Testament fulfilments of those types, such as the miracle of Cana.

In his design Anrep chose to interpret, in his own idiom, the style and spirit of the mosaics of Rome and Ravenna from the Early Byzantine period. It seems he was primarily inspired by the mosaics of San Vitale, Ravenna (the

Plate 11 The Noah scene, Sacrament Chapel

Plate 12 Detail of the blinding of St Paul, Chapel of St Paul

polychrome earth, for example), supplemented by the polychrome cloudy sky and the jewelled cross in the apse of St Pudenziana, Rome, and the jewelled cross, the rivers of Eden and Paradise as a walled city in the apse of St John Lateran, also in Rome.

There are more Byzantine features. The Archangels Michael and Gabriel are depicted in Byzantine court costume; God the Father is shown only as a hand from a cloud; figures have both eyes always visible and these figures are not naturalistic but stylized; for instance, the Noah family and the apostles in the Feeding of the Five Thousand look carved from a single block. In the Noah scene events are presented simultaneously: the dove with the olive branch; the beached ark; the sacrifice; the rainbow (**Pl. 11**). There are a few idiosyncratic touches, such as the sky: the ground is pink, not a colour with a symbolic role in Byzantine art or even modern Russian Orthodox art. Nevertheless, *pace* J.R. Clayton and Tom Phillips, Anrep's neo-Byzantine mosaics are a triumph, 'very Greek', as Bentley wished.

Meanwhile Aelred Bartlett (a Catholic) designed grapevine mosaics for the transept arch soffits, and himself made a St Nicolas for an aisle niche. He and his brother Francis had previously advised on marbling the lower nave and had even found rare marbles for that purpose. But some committee members resented the influence of the brothers, and Rothenstein even threatened to resign over the Nicholas. When Aelred Bartlett submitted designs for St Paul's Chapel they were rejected and Rothenstein made sure Anrep was invited instead. Anrep felt he was too old and suggested his assistant, Justin Vulliamy, with himself supervising. This suggestion was accepted.[27]

Vulliamy's St Paul's Chapel is in the neo-Byzantine style of Anrep; there is the same pink in the tent ceiling and a polychrome earth. The scenes depict Paul's blinding on the road to Damascus, with Christ and the saint enclosed in a Byzantine mandorla; the Damascus basket escape, the shipwreck and the site of Paul's martyrdom. The east wall shows Christ flanked by Peter and Paul, and below them the pale grey-blue apse is filled with sun, moon and stars. It is the only weak point of the design; as the chapel's prime focal point it appears an anti-climax. Nevertheless, in its quieter, cooler way, this chapel is as successful as the Sacrament Chapel. The various little towns and buildings are charming Byzantine miniatures (**Pl. 12**). The St Paul's Chapel was completed in 1964, and apart from one exterior mosaic there followed a pause of over 30 years.

By the 1990s, the committee included a historian of architecture, a critic of architecture, an expert on Victorian art and architecture, an expert on 19th-century Catholic architecture and three architects. Absent was any professional expertise on Byzantium or mosaic. In 1997, to follow Anrep and Vulliamy, the committee commissioned another mosaic artist, Trevor Caley, to make a panel of St Patrick. Patrick's face, inspired by Early Byzantine mosaics, is more naturalistic than stylized. The saint, who holds a gleaming shamrock and a crozier, is credited with ridding Ireland of snakes, and Caley has wittily symbolized this by showing Patrick treading on a snake which segues into the Celtic stole he wears. In many ways, iconographically and technically, this is a masterly mosaic, which unusually for the cathedral was made with a blend of smalti and ceramic tesserae (**Pl. 13**).

After this the committee reverted to the practice Bentley had begun of commissioning designs from painters. For a panel of St Alban, a design was commissioned from Christopher Hobbs, a self-taught painter, sculptor, stage and screen designer, but not a mosaicist. Alban was a 3rd-century Romano-British saint, so Hobbs modelled the face

Plate 13 St Patrick, Chapel of St Patrick

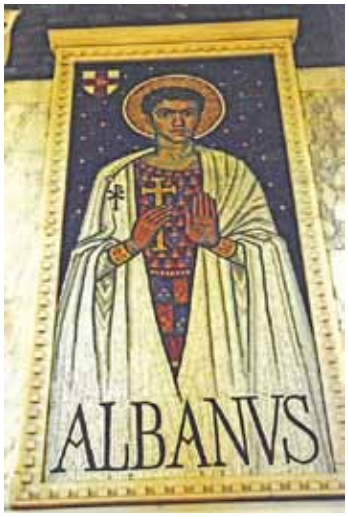


Plate 14 St Alban

Plate 15 The Holy Family, Chapel of St Joseph

on 2nd-century Egyptian mummy portraits. Alban is robed in white, as befits a martyr, and his neck has a thin red line to denote the manner of his death: decapitation (**Pl. 14**). The result is an impressive Early Byzantine-style saint, and the almost pointilliste design was realized as mosaic by Tessa Hunkin of Mosaic Workshop.

The committee also asked Hobbs to design the Chapel of St Joseph. On the east wall he placed the Holy Family in the Byzantine manner; on the west wall workers building the cathedral; and on the ceiling, a woven basket design, suggesting a manger. Hobbs clearly did his research: icons and Egyptian mummy portraits were the inspiration for the Holy Family, and the child Jesus' clothing has Byzantine-style gold highlights. It was presumably Hobbs' experience in theatre design which ensured that these mosaics can be read both close up and at a distance (**Pl. 15**).

On the other hand a Byzantinist would have known that in Orthodox iconography Joseph never has his arm round Mary. As for the Holy Spirit in the form of a dove, when a photographer was setting up to photograph the Holy Family, he asked reverently, 'Shall I include the duck?'[28] To be fair it does look like a reject from *Chicken Run*. The ceiling weave design, despite the gold, is much duller than, say, the fish-scale Andrew ceiling, and the Workmen Building the Cathedral wall looks like a scene from a child's illustrated Bible.

Hobbs adopted a different style for the Thomas Becket mosaics in the Vaughan Chantry. These mosaics are a charming medieval pastiche, as in the Chapel of St Gregory. There is one flaw, the large red-and-white voussoirs around the window, for in full light they pull focus from the dark blue beauty of the ceiling. The committee may not have included a mosaicist but one would have hoped they knew how colour works (**Pl. 16**).

By the early 21st century the committee comprised mainly historians of architecture, church architecture, Victorian architecture, British architecture, Catholic architecture, with some expertise on British art, and they asked Leonard McComb, another painter new to mosaic, to design a St Francis (2008) and a St Anthony (2010) for the holy water apses. With two of McComb's students for models the rather bland neo-Byzantine saints are portrayed uncomfortably in an aviary and an aquarium respectively (**Pl. 17**). The painter Tom Phillips had in fact designed one mosaic before being asked to do a Cardinal Newman panel (2008). Phillips disapproved of trying to re-create Byzantine mosaics in a Victorian building,[29] and the face of his Newman at prayer is indeed closer to a Victorian-style portrait; it could almost have been painted by Bentley (see **Pl. 3**). The rectilinear ground, however, is in modern poster colours (**Pl. 18**).

Plate 16 Becket mosaics, Vaughan Chantry

Plate 17 St Francis, holy water apse

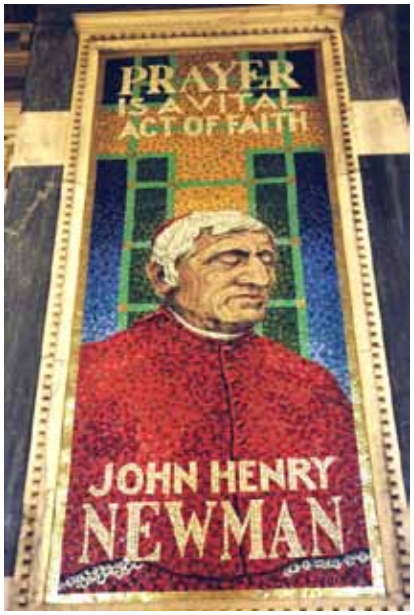


Plate 18 Cardinal Newman

But then the committee took a new direction. Previously in the cathedral chapels there had been Victorian art nouveau, Victorian Gothic, 'Child's Illustrated Bible', medieval pastiche and neo-Early Byzantine mosaics. But in 2007 they commissioned a design from Phillips in what was very much his own idiom. To commemorate the Forty Martyrs in the Chapel of St George Phillips came up with the idea of the light of faith shining in the darkness. Hence he placed a transfigured Tyburn gallows scene on the west wall, a cut-marble dawn on the east wall, and a dark blue ceiling strewn with flaming leaves, each inscribed with the name of a martyr. The cathedral administrator announced that the committee was unanimously enthusiastic about the design. Others have dissented. One challenge for the mosaicists was the Tyburn design; its subtle blending of pastel colours would seem to call for something approaching micromosaic to be achieved. But surely mosaic is at its best when it reads as mosaic, when the viewer can enjoy the fact that the pattern or picture is made up of obvious pieces, and can also enjoy the *andamento*, the flow of those pieces within the design.[30]

There were elements of innovation also in Ivor Davies' 2010 neo-Byzantine St David panel. In a bold gesture David has a Celtic (to our eyes Mohican) tonsure. He drank only water, so arcs of silver water pour towards him as he stands on a mound founded on actual Welsh rock. Davies, yet another painter with no experience of mosaic, perhaps did not realize how focus pulling the swathes of gold and silver ground would be; his David, despite the white attire, comes across as the patron saint of bling. Inexperience perhaps also explains why David's head is too small, as viewed from the floor (compare the larger head in Anrep's Plunkett along the aisle, which is also overloaded with gold and silver (**Pls 19–20**).

At this point one should ask: was Bentley right in thinking a non-mosaicist could design a successful mosaic? Would it not be bizarre to ask, say, a watercolourist to design a sculpture? There have been mosaic catastrophes in the past; for example, Marc Chagall's design for a floor in the Knesset, Jerusalem. He produced a rough sketch which totally ignored the fact that mosaics are made of small, hard pieces of glass and stone. His distinguished predecessors Veronese and Tintoretto produced equally unsuitable cartoons for mosaics in St Mark's, Venice. Mosaic is a medium which makes particular demands and is at its most effective when simple and strong, with a limited palette.[31] It is surely more likely that artists who have been making mosaics for many years will produce more successful designs than a tyro, because *ab initio* they will be thinking mosaic; the medium and the concept will be one. There is another drawback to tyros: Tessa Hunkin found it took a long time to choose a tonally blended mosaic palette equivalent to the colours in Hobbs' design: 'It's a hundred times more complicated, using someone else's painting.'[32]

Apart from Anrep and Vulliamy the cathedral has never commissioned chapel mosaics from mosaic artists, even ones of such distinction as Gino Severini, Hans Unger and Eberhard Schulze, Desmond Kinney, Verdiano Marzi, Charles Lutyens, Marjorie Knowles and Brian Bull, to name a few. Of course some might have been too 'modern' for a cathedral where the figurative mosaics have all been within

Plate 19 St David, aisle between the Chapels of St Andrew and St Paul

Plate 20 Blessed Oliver Plunkett, aisle outside the Chapel of St Patrick

Plate 21 Silver ground, Holy Souls Chapel

Plate 22 Gold ground, Chapel of St Gregory and St Augustine

certain stylistic parameters. The fact is however that cardinals and committees have tended to commission what they know: painters. Were they right to conclude that a painter and a mosaicist are the acceptable equivalent of a mosaic artist? Are the mosaics in the cathedral designed by painters as good as those designed and made by mosaicists? Is Hobbs' St Alban as good as Caley's St Patrick? Is Symons' Holy Souls chapel as good as Anrep's Blessed Sacrament?

There are other important questions which need to be answered when contemplating the completion of the mosaics of the cathedral.

Questions of technique

Bentley favoured making mosaics *in situ*. This method was used for the Holy Souls, Sacred Heart, Andrew and Lady chapels, also for the sanctuary tympanum, the confessional alcove, the Joan of Arc and Christ the Healer panels and the gold ground in the Chapel of St Joseph and the Vaughan Chantry. Here the mosaicist works in three dimensions by varying the height and the angle of each tessera, and can judge the effect in the on-site lighting, as Bentley and Bridge were aware. Again *in situ* mosaic is self-grouting, since the mosaicist pushes each tessera into the setting bed; hence before selecting a given colour he or she can judge to what extent the colour of the bed would affect the final result.

All the other mosaics in the cathedral are in indirect (reverse) technique. This method involves making the mosaic face down onto backing paper on a table. The advantages are that the mosaicist can make the mosaic in the comfort of a studio and the installation time on site is greatly reduced. One disadvantage is that when installed the mosaic is as flat as the table, is 'two-dimensional' in other words, and unlike *in situ* 'three-dimensional' mosaic cannot reflect glittering, multi-faceted light. Also the tesserae colours are chosen in the studio, so when working on site the only colour choice the mosaicist has is the colour of the grout. The grout colour can indeed greatly affect how the colours of the mosaic are perceived, and the final effect also depends on the width of the grouted gaps between tesserae.[33]

There are in fact direct methods available to studio mosaicists. One technique is to glue tesserae onto mesh, and the resulting mosaic is pressed into the on-site setting bed. Another is to make the mosaic direct onto boards or metal sheets, which are then bolted to the on-site wall. Trevor Caley used this method for his St Patrick panel.

There is no doubt that the liveliness of direct mosaic is vastly preferable to the flat indirect type. Anrep was aware of the problem and once his reverse mosaics were up on the walls, he started tapping tesserae with a hammer to give the surface some life. He did not succeed; if you stand between his Sacrament Chapel and the *in situ* Sacred Heart Chapel and compare the two you will see the difference is great. But the committee has not as yet (2012) set its face against the reverse method. Of course, leaving aside the texture of the surface, much depends on the skill of the mosaicist who turns an artist's painting into mosaic. With Hobbs, Phillips, McComb and Davies, it was Tessa Hunkin, the Gertrude Martin of our day.

The setting of the backgrounds influences the appearance of a mosaic greatly. Bentley said, 'The individuality, not only of the principal, but of each worker should be freely expressed in the work, although under one control.' [34] The ladies who worked on the Holy Souls silver ground seem to have ignored control and taken his advice literally; their *andamenti* are mostly chaotic (**Pl. 21**). Interestingly, in the Chapel of St Gregory the gold ground by the same workers is in rigid lines (presumably as ordered by the designer, Clayton), as is the gold ground in Pownall's Lady Chapel (**Pl. 22**). In fairness to Clayton and Pownall it has to be said that almost all Byzantine gold ground is in straight lines. But then those mosaics are usually at some considerable distance from the viewer, and hence the straight lines do not read as such.

Plate 23 Gold ground, Chapel of St Joseph

The fish-scale (direct) gold ground in the Chapel of St Andrew is impressive, and in the Chapel of St Joseph the lively gold ground around the (indirect) Holy Family was done *in situ*, in an apparently random but actually carefully considered pattern. Being *in situ* it has life lacking in the chapel's otherwise reverse mosaics, and unlike the Holy Souls silver ground it does not distract (**Pl. 23**). In panels, closer to the viewer, the *andamento* assumes immediate importance. For example, Alban and David wear large white robes and the mosaicist must decide how flowing or rigid the *andamento* will be (**Pls 14**, **19**).

Almost all the mosaics have been made with smalti and gold and silver tesserae. The smalti have survived well. But in 1962, in the Holy Souls Chapel, there appeared a problem with the 'silver' tesserae, which were in fact platinum (to prevent tarnishing). Several cartellinae had come off, and the base glass itself was degrading. Tests were undertaken using scanning electron microscopy, x-ray diffraction, infra-red microscopy and ion chromatography. These revealed deterioration as a result of causes other than structural movement or water penetration. It was concluded that some of the material was inherently unstable. Dr Norman Tennent, then of Glasgow University, had carried out the tests and in 1993 wrote a report, as a result of which, 'Repairs were carried out in the Holy Souls Chapel by removal of loose fragments prior to rebuilding the surface with resin, upon which metal leaf was applied, protected by acrylic resin.' This was preferred to removing tesserae, which might damage surrounding areas.[35]

A perennial question is how to prevent the cartellinae coming off gold and silver tesserae, leaving what look like black holes. The Byzantines never achieved total success, and neither has Westminster Cathedral. The whole question of getting the glass-metal-glass combination to bind permanently has prompted much discussion. Some have thought the secret is to use egg white; then an Orsoni brochure says: 'It would be interesting to make a thorough study of the pressure co-efficients (coefficienti di tensione) of glass and gold – another well-kept Orsoni secret.'[36] And Marco Verità says that to make gold and silver bind chemically to glass the metal surface must be covered by a thin layer of oxide; the problem being that gold and silver do not oxidize easily.[37] It would appear that the only way to guarantee that cartellinae will stay put is if there are perforations or fissures in the metal leaf, so that the glass base fuses directly with the glass cartellina – glass fuses to glass, in other words.

It is well known that tesserae have fallen out of Byzantine setting beds made of lime plaster. The alternative used for the Holy Souls, Gregory and Sacred Heart chapels was 'mastic' devised by George Bridge. The Holy Souls mastic has been analyzed; it is a mixture of beeswax, whiting (ground chalk) and linseed oil, coloured with red lead.[38] But there have been failures with Bridge's mastic, notably so in the Gregory and Sacred Heart chapels.

More successful was the Chapel of St Andrew bed. Gaetano Meo is thought to have used the same 'mastic' he used in St Paul's Cathedral. The ingredients are supposed to be nearly identical to those employed in the 16th-century restoration of the mosaics in the Florence Baptistery.[39] Anrep and Vulliamy used Portland cement beds and grout, which seem to have held. More recent mosaics have used 'ceramic tile adhesive' with a polymer additive to improve cohesion.

And in the future…

The cathedral authorities are now (2012) considering completing the mosaics of the upper regions of the building. Next to funding the project the most important decision is what adhesive to use. In other large churches there have been failures with cement: the St Louis Cathedral in the USA, with mosaics installed from the 1920s to 1988, has had falling tesserae. The National Shrine in Washington reports no such failures – the setting bed there was 'Portland cement with nylon fibre reinforcement'.[40]

Of the modern adhesives the alternatives seem to be either cementitious (ceramic) adhesives or epoxy glues. The problem is that no one knows how long these will last. Oliver Budd reports that a mosaic fixed with cement-based Bal Flex has survived intact for 51 years, but that is not long in the life of a cathedral.[41] There are ageing chambers which could test durability, but clearly exhaustive tests must be done before a decision is made.

Plate 24 The nave in mystic gloom

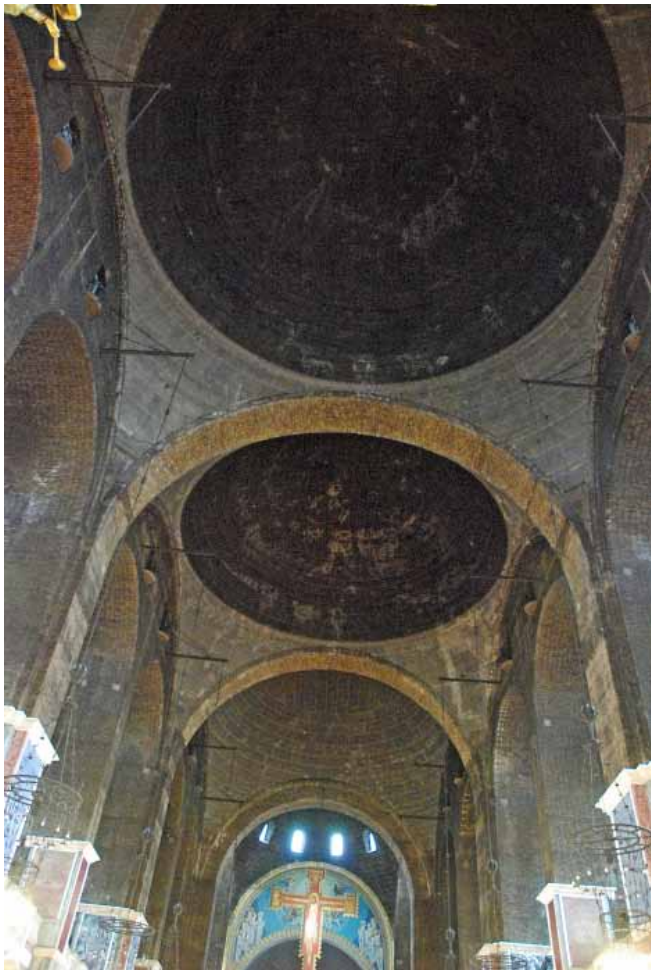


Plate 25 The nave in afternoon sunlight

Then the method: *in situ* or off site? There are about 8500m² of mosaic to be made. If they were made in a studio direct on mesh that might take two or three years. Installation would be much quicker; depending on the number of fixers it could be done in six months, plus time to erect scaffolding and prepare the surfaces.

However it now appears the mosaics might be made *in situ* as Bentley wished, even though this would take several years. Temporary scaffolding was erected recently to allow checks and repairs to the nave ceiling. The scaffolding did not interfere with the services and was generally thought attractive, rather more so than the normal sooty brick and stained concrete. There are those who revel in the mystic darkness of the upper regions (**Pl. 24**), but perhaps they have never seen the upper regions in strong afternoon sunlight (**Pl. 25**).

Should the mosaics be figurative or not? Bentley assumed there would be many figures, as in St Mark's and this was certainly true of the various schemes proposed in the early years.[42] It was also true of the 2008 scheme produced by the then administrator and colleagues.[43] But some people would prefer a much simpler solution. Eric Gill, the sculptor, was asked to propose a design for the sanctuary apse, and he argued that traditional figurative mosaics, as in Ravenna, were not in keeping with the times, and that the apse should be plain gold with a simple text. He felt moreover that if this simple approach were followed throughout the cathedral its great beauty and dignity would be enhanced, whereas elaborate figures might damage its scale and proportion.[44] It remains to be seen which view will prevail.[45]

If it is decided that in the domes and high vaults gold ground will predominate, then to avoid the cathedral appearing 'like a bath of *Ambre Solaire*'[46] various devices will be needed. The Byzantines sought variety by angling the tesserae and seasoning the gold mosaic ground with other materials. In the cathedral could there be effective *andamento* 30m above the viewer? Not if standard 2cm tesserae were used, but suppose much bigger ones were employed? Modern adhesives and lightweight glass might make this possible.

Should a painter or a mosaic artist do the design? It is difficult to argue in favour of painters; since the early 1990s mosaic has taken off in Britain and elsewhere; there are hundreds of mosaic artists worldwide doing excellent work with a very broad range of subjects, styles and materials, including smalti. The gold mosaics of Lucio Orsoni and Elaine M. Goodwin in particular are outstanding. There is an International Association of Contemporary Mosaicists and mosaic associations in the UK, USA, Germany, Japan and Australia. There are journals, exhibitions, websites, workshops, books and DVDs. There are even new members of the cathedral committee who very definitely 'think mosaic'.

As regards the iconography and style of the new mosaic scheme for the cathedral, the history of the existing mosaics offers much food for thought. Here too it remains to be seen what the Archbishop of Westminster and his advisers will choose.

Notes

1 The actual figure is 8456m². This includes all the interior ceilings of the main building apart from the chapels, the sanctuary tympanum and the north entrance porch. If those are included the total mosaic area is around 10,000m². By comparison St Mark's in Venice has some 4,000m² of mosaic; Monreale Cathedral in Sicily just over 6,000m²; and the modern St Louis Cathedral, USA, approaches 8,000m². Hagia Sophia in Constantinople has some 16,000m².

2 Westminster Cathedral was not in fact Bentley's first project in the Byzantine style. In 1874 he had been asked to remodel the Church of the Assumption in Warwick Street, London, on Byzantine lines. Financial considerations meant that he only designed the sanctuary apse. See J.B. Bullen, *Byzantium Rediscovered*, London, 2003, 173.

3 W.R. Lethaby and H. Swainson, *The Church of Sancta Sophia, Constantinople: A Study of Byzantine Building*, London/New York, 1894.

4 *The Westminster Cathedral Record*, No.1, January (1896), 16.

5 See R. Krautheimer, *Early Christian and Byzantine Architecture*, The Pelican History of Art, London, 1986, 242–4.

6 P. Doyle, *Westminster Cathedral 1895–1995*, London, 1995, 37.

7 There is no record of the mosaics of St John's.

8 W. de L'Hôpital, *Westminster Cathedral and its Architect*, vol. 1, New York, 1919, 242.

9 Ibid., 247

10 Ibid., 247. In the cathedral archives there is a drawing and notes for an 1899 scheme by Bentley for a St Patrick chapel, a scheme similar to Symons'. Indeed, Bentley's silver vault with green wreaths became part of Symons' design: see, P. Rogers, *Reflections: The Westminster Cathedral Mosaics*, London, 2010, 16–17.

11 De L'Hôpital (n. 8), 248.

12 Ibid., 249, 250.

13 With the 'modern Italian' method the mosaic was made in a studio. It involved transferring cartoons to heavy paper which was then

divided into numbered sections. The tesserae were pasted face down onto the paper and when each section was complete a layer of cement was laid over it to bind it together, and this was covered with squares of slate or similar material. The sections were taken to the site to be cemented in place, after which the paper was soaked off, revealing the mosaic. The firm of Salviati, founded in Venice in 1859, claimed to have invented this method but it was already well known in North Africa and the Levant. See S. Barr, *Venetian Glass Mosaics 1860–1917*, Woodbridge, 2008, 12,13, and R.A. Bell, 'Notes on the practice of pictorial mosaic', *Journal of the Royal Institute of British Architects* IX (1901), 31. The modern version of this method omits the layers of cement and slate and relies on the paper to bind the mosaic together *pro tem*. This 'reverse' or 'indirect' method produces mosaics as flat as the tables they are made on.

14 De L'Hôpital (n. 8), 248–9.
15 Ibid., 249.
16 Ibid., 202.
17 In or shortly after 1900 Bentley produced sketches for a mosaic in the apse of the Church of Our Lady of the Assumption, Warwick Street, London, where he had earlier remodelled the apse in the Byzantine style (see n. 2). The mosaic depicts The Coronation of the Virgin. The style is Victorian. See W. de L'Hôpital, *Westminster Cathedral and its Architect*, vol. 2, London, 1919, 451–2. Previously Bentley had designed an Adoration of the Magi mosaic for this church, also Victorian in style (**Pl. 3**).
18 De L'Hôpital (n. 8), 161.
19 Ibid., 154.
20 See n. 13.
21 R. Guilding, 'The word made mosaic. Tom Phillips talks to Ruth Guilding', *Apollo* (January 2008), 36–41, esp. 38.
22 Rogers (n. 10), 30.
23 Ibid., 33.
24 Ibid., 33–40.
25 De L'Hôpital (n. 8), 224.
26 There is a legend that Trinick was in a pew waiting to go to confession and saw workmen turn up and start removing his mosaic, which was to be replaced by a bronze relief.
27 Rogers (n. 10), 54–6.
28 Interview with the author, 2003.
29 See n. 21.
30 The St George mosaics have not yet (2012) been made. The designs can be viewed on the Internet by searching 'Phillips George mosaic'.
31 The colour range of the smalti in Byzantine mosaics was often limited. In the narthex lunette of Christ in Hagia Sophia, Constantinople, there are only 23 colours: two reds, two yellows, three greens, four blues, four purples and three browns. The mosaics of Orvieto Cathedral have 39: five blues, ten reds, five violets, eight greens, five yellows, three flesh tones and three blacks. In the apse of San Vitale there are 40: five blacks, nine blues, five greens, six flesh tones, and so on. In Middle Byzantine mosaics it appears that only three to five shades of the various colours were commonly used.
32 Interview with the author, 2003.
33 See E. Biggs and T. Hunkin, *Mosaic Workshop*, Newton Abbot, 1999, 25, 27.
34 De L'Hôpital (n. 8), 249.
35 From the *Mosaics* section in the *Westminster Cathedral Architect's Report 2008*, in the cathedral archives.
36 See *Orsoni Mosaici*, Angelo Orsoni snc, Venice, 1994, 16.
37 M. Verità, 'Mosaico vitreo e smalti: la technica, i materiali, il degrado, la conservazione/Glass mosaic and smalti: technique, materials decay and conservation', in C. Moldi (ed.), *I colori della luce: Angelo Orsoni e l'arte del mosaico*, Venice, 1996, 80.
38 Rogers (n. 10), 17.
39 See *Andamento, Journal of the British Association for Modern Mosaic* (BAMM) 4 (2010), 11.
40 Email to the author (31 January 2012) from Geraldine M. Rohling, Archivist and Curator, National Shrine of the Immaculate Conception.
41 Email to the author (21 February 2012) from Oliver Budd of Budd Mosaics.
42 See de L'Hôpital (n. 8), 228–42.
43 For more information, visit www.mosaicmatters.co.uk/news and click on the link entitled 'A scheme to finish off Westminster Cathedral'.
44 Doyle (n. 6), 84.
45 In any scheme a decision would have to be made as to whether to retain or remove Pownall's sanctuary tympanum. Bentley's 30ft (9m) sanctuary Cross (a western feature, not Byzantine) will have to stay, despite its masking of the tympanum and the apse. Pope Benedict likes it.
46 See J. Gage, *Colour and Culture: Practice and Meaning from Antiquity to Abstraction*, London, 1993, 41.

Glossary

acheiropoieiton (Greek, 'not made by human hands'): term used to describe images, usually depicting Christ, which initially appear miraculously, often with the ability to replicate themselves without human intervention
andamento (Italian, 'flow' or 'direction'): term used in reference to mosaics to describe the visual movement produced by the arrangement of rows of tesserae
apse: semi-circular or polygonal recess at the east end of a church
barrel vault: vault with a continuous surface of semicircular or pointed sections usually made from stone or wood which resembles a tunnel that has been cut in half lengthwise
bema (Greek, 'raised step'): sanctuary in an Orthodox church, typically raised and accessible only to the clergy
buttress: supportive masonry or brickwork built against or protruding from a wall to provide reinforcement
cabochon: unfaceted gemstone cut and polished to a rounded shape
calchi (from Spanish 'calco', 'tracing'): rubbing or impression made by laying a piece of paper over a surface, and then rubbing with a crayon or other drawing tool
cake: coloured glass disc
cartellina: thin layer of blown glass which protects the metal leaf in gold or silver mosaic tesserae
clerestory: upper structure above the nave in a church, usually with rows of windows which admit light
coefficiency of expansion: the ratio of the change in the length or volume of glass to its original length or volume per unit change in temperature
confessio: crypt consisting of a series of linked passages
cylinder technique: technique for producing flat sheets of glass. A glass bubble is blown into a cylinder shape and when the correct size and length, it is detached from the blowpipe and cut at either end and slit lengthways. Two sides are then uncurled to form a flattened sheet of glass
diakonikon (Greek, 'space used by deacons'): chamber or chapel, usually to the right of the sanctuary of an Orthodox church, which acts as the sacristy
dichroic (Greek, 'two coloured'): term used to describe glass that contains one or more layers of transparent metal oxides enabling it to appear one colour in reflected light and another colour when light is transmitted through it
diatreta (Greek, 'reticulated cup'): glass vessel consisting of an outer shell that has been carved away to leave an open network which is joined to the inner layer by struts, stems or shanks
encheirion (Greek, 'handkerchief'): rectangular piece of cloth embroidered with gold, attached to a belt and worn as a vestment by a bishop, or hung from an icon
epitracheilion (Greek, 'around the neck'): embroidered strip of cloth worn around the neck and over the liturgical vestments of priests and bishops, usually made of silk
exonarthex: outer narthex of a church with two narthexes
grisaille: monochrome painting in shades of grey
groin vault: vault produced by the intersecting right angles of two barrel vaults, the arches of groin vaults may be pointed instead of round
groze: to trim a piece of glass to shape
Hodgeteria (Greek, 'She who shows the way'): an icon type

in which the Virgin Mary holds the Child at her side and points to Jesus. From the early 8th century it was believed that St Luke the Evangelist painted the first image of this type from life

intradros: lower or inner curve of an arch

katholikon (Modern Greek, 'general'): the main church of a monastic complex, usually dedicated to the donor or patron saint of the monastery

koutrouvion: small ampulla or flask, often used for transporting liquids

lear (or leer, lehr): oven used for gradually and uniformly cooling glassware

Mandylion: miraculous image of Christ on a cloth, legendarily sent to cure King Abgar of Edessa, and brought from Edessa to Constantinople in 944

muff process: *see* cylinder technique

naos (Greek, 'temple'): refers to a church, specifically the centre of a Byzantine church where the congregation worshipped

narthex (Greek, 'stalk'): in Byzantine architecture, transverse vestibule of an Orthodox church at its entrance facade

omphalio (Greek, 'navel'): sacred conical object, usually a stone

opus tessellatum: mosaic technique using uniform sized tessarea to ground pictorial and decorative designs, often used for backgrounds consisting of tessarea arranged horizontally or vertically

opus sectile (Latin, 'cut work'): inlay technique applied to floors and walls using cut pieces of marble, sometimes mother of pearl or glass

parekklesion (Greek, 'side chapel'): subsidiary chapel joined to the side of a church, often used as a funerary chapel

Paterikon (Greek, 'books about the fathers' or 'lives of the fathers'): collection of lives of saints, martyrs and Desert Fathers

pentimento (Italian, 'repentance'): visible trace of an earlier painting beneath a layer or layers of paint on a canvas

poikilia* or *varietas (Greek, 'diversity'): Byzantine liturgical and luxury objects were set in rich spaces of mosaics, marble, fragrance and changing light. They possessed polymorphous appearances, which were set to perform when the vessels were carried in space or when shifting ambient light or density of air ruffled their variegated textures. The Byzantines called this spectacle of change *poikilia* (phenomenal presence effects experienced by the senses)

prothesis (Greek, 'offering'): chapel, usually to the left of the bema, used to prepare the offerings for the liturgy; also the preparation of the bread and wine for liturgical service

repoussé: metalworking technique in which metal is hammered from the back to raise a design in relief

rotae (Latin, 'wheel'): wheels, referring to the animating principles of the stars and planets

revetment: metal covering usually made of gilt or silvered metal and set with precious stones and pearls to protect a surface, normally fixed over certain parts of an icon, leaving the head, hands and feet of the depicted person depicted

sebastokrator: Byzantine title formed from a combination of the words *sebastos* (venerable) and *autokrator* (ruler), typically awarded by the emperor to his sons and other relatives, first created by Alexios I for his brother Isaac Komnenos

skouterios (Greek, 'shield bearer'): officer who bore the emperor's emblem and shield during imperial and ceremonial processions, known from the thirteenth century onwards

smalti: opaque coloured glass available in a range of colours

soffit: underside of an architectural feature such as an arch, vault or balcony

support: tesserae composed of a transparent colourless glass which is used as a support for the gold leaf

transenna (Latin, 'lattice-work'): lattice or open screen of metal or stone, usually marble, enclosing a shrine in early Christian architecture

tribelon (Greek, 'three curtains'): three arches supported by two columns or pillars creating three openings, the central one of which is generally slightly larger than the two either side

tympanum: semicircular area enclosed by the lintel of a doorway and the arch above it, often decorated with sculpture

undercut: process of decorating glass in high relief by cutting away part of the glass between the body of a piece and its decoration, for example on a diatreta

Glossary compiled by Rebecca Raynor